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1. MANAGEMENT

Gas Industry Expansion

Natural Gas Production and Use Are Expanding Steadily. *World Oil 150,* 92 (1960) Feb. 15 (2 pp.)

Marketed production of natural gas, estimated by this forecast review issue of *World Oil,* increased by 3.3% to 11,400 billion CF in strike-troubled 1959, the same amount as in 1958. Production promises to increase by a larger percentage during the expected boom of 1960. Average wellhead price was $0.119 in 1958 and $0.121 cents in 1959. Of the total consumption, residential use was 2,900 billion CF by 30.3 million consumers.

New Machine Can Make Line Pipe Right-of-Way. *Oil Gas J. 58,* 60 (1960) Feb. 15 (2 pp.)

A new trailer-mounted mill capable of converting ribbons of metal into spiral, double-welded pipe is now being used on several lines being laid in Europe and Africa. A variety of mills are available which will make pipe in several sizes, ranging from ½-in. to 120-in. in diameter. Development is credited to Dr. Vilem Eckhardt, a Czech refugee now living in Western Germany, whose firm is represented in the U. S. by the Driam Div. of David Douglas & Co. in Manitowoc, Wis. Similar mills are being offered or planned by other firms.

Trans-Canada Looks Southward. *Gas Age 125,* 124 (1960) Feb. 18 (4 pp.)

Trans-Canada Pipe Lines Ltd. has filed a long-awaited application for a permit to export natural gas to the U. S. Application is in three parts: 1) license to export 204 MMCF/day to Midwestern Gas Transmission Co. from Emerson on the Manitoba-Minnesota border; 2) permission to construct and operate a large diameter pipeline from Winnipeg to Emerson, a distance of about 51 miles; and 3) a license to export surplus quantities of gas on an interruptible basis up to 204 MMCF/day from a point on the border, near Niagara Falls. If application is approved, natural gas can become one of Canada's prime earners of U. S. dollars, second only to pulp and paper in this category.

Gas Industry Management

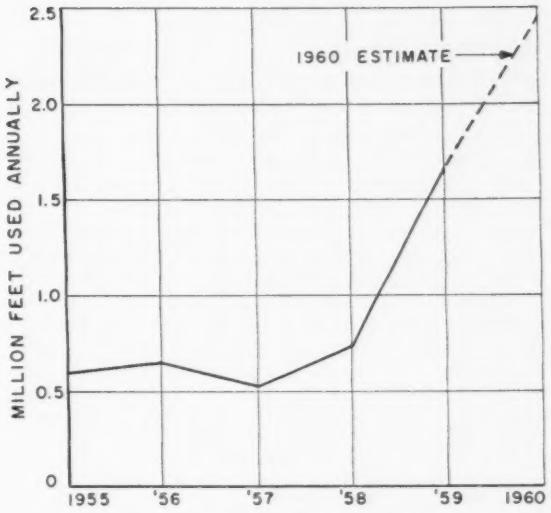
Are We Meeting the Union Challenge? E. A. Hartsook. *J. Petrol. Tech. 12,* 13 (1960) Feb. (5 pp.)

A review is presented of labor's growing efforts to organize scientific and professional people. Article warns of unionization's tendency to stifle individual achievement. Positive programs are outlined for management and professional societies to follow in promoting professionism in engineering.

Estimating Future Costs. W. Copulsky and R. Cziner. *Chem. Eng. Progress 56,* 46 (1960) Feb. (4 pp.)

Estimating production costs, plant investments, and profits has become a highly developed art among chemical engineers. Proper planning demands that costs and profits be evaluated on a dynamic basis; cost estimates can be prepared for one or two years ahead. Historical trend analysis, correlation analysis, and survey of executive and business opinions are three forecasting techniques discussed. Seven graphs of cost data are presented: 1) purchasing power of dollar; 2) yearly gross national product; 3) hourly wages of chemical production workers; 4) fuel prices of gas, coal, and crude oil; 5) index of plant maintenance costs; 6) freight rates; and 7) chemical construction costs. A table is presented of components of typical cost estimates, together with a sample estimate to show correct procedures.

Growth in Plastic Pipes Usage



(Adapted from *1960 Plastics Pipe Survey . . .* See Abstract, p. 64)

Air Pollution

Contaminant Emissions from the Combustion of Fuels. R. L. Chass and R. E. George. *J. Air Pollution Assoc. 10,* 34 (1960) Feb. (10 pp.)

Demand for thermal energy in Los Angeles County will at least double within the next eight to ten years. All of this demand is being met with petroleum and natural gas fuels. From an air pollution point of view, petroleum fuels are totally undesirable because of industrial emissions each day of tons of air contaminants. The most desirable fuel for power generation is natural gas. However, from the forecasts of thermal energy requirements and natural gas supplies for the Los Angeles area there will not be enough gas to meet the estimated demand. Variable annual demands for natural gas by firm users will require that some fuel oil be burned, by interruptible users. Since oxides of nitrogen play an important role in the photochemical reactions occurring in Los Angeles County, steps should be taken to determine the

degree to which emissions of these nitrogen oxides can be controlled.

Education

Advances in Engineering Education with an Analysis of the Effect on the Oil and Gas Industry. C. V. Kirkpatrick. *J. Petrol. Tech. 12,* 31 (1960) Feb. (6 pp.)

Article presents a comprehensive survey of the current status of enginering education in the U. S. and analyzes the effect of some of the recent advances on high schools, colleges and universities, and industry. It is noted that many constructive and critical appraisals of engineering education in the U. S. were made several years prior to Sputnik I and that many of the recommendations incident thereto had already been put into effect. A commonly accepted engineering core curriculum is given and the dynamics of its contents are reviewed. It is concluded that, although college and university curricula are still undergoing significant changes, many constructive advances have been made.

Federal Power Commission

Coping with Today's Regulatory Problems. G. R. Perrine. *Public Util. Fortnightly 65,* 217 (1960) Feb. 18 (10 pp.)

Problems and possible solutions for today's utilities are presented by the chairman of the Illinois Commerce Commission. Reasons for public ignorance about public utilities are discussed. Author suggests that the A.G.A. see to it that proper publicity be released daily to the press, and articles about utility problems be written and placed in leading magazines. A solution to the problem of gas pricing must be found. Undue delays may result in withholding of gas reserves to interstate pipelines. Regulatory bodies may have to re-examine their rate of return philosophies in light of today's high cost of money. It is simply not sound policy for the government, which has to pay about 4-5% for its money, to loan money to the electric cooperatives for 2%. Funds resulting from accelerated depreciation should be used for plant expansion, thereby benefiting both the public and utilities.

Foreign Activities

Iran Has High Hopes for Next 5 Years. *Oil Gas J. 58,* 82 (1960) March 7 (2 pp.)

Abdollah Entazam, chairman of the government-owned National Iranian Oil Co. outlined the five-year goals in a recent speech in Teheran. He estimated that NIOC will have to spend $121.5 million for distribution equipment, but the investment can be amoritized within ten years. A new refinery at Teheran with at least 40,000 bbl capacity will be built during this period. Gas reserves of Sarajeh were estimated at seven trillion CF, and condensate reserves at more than 400 million bbl. Pipeline construction to take gas to Teheran will cost $27 million, but revenues from the sale of the gas in ten years will amount to $108 million.

Gas Lighting

How We Revived the Gas Light. *Gas Age 125,* 34 (1960) Feb. 18 (2 pp.)

No one in Arkansas Louisiana Gas Co. considers gaslights a fad. They have become a very profitable business, both in production and distribution. They are an ideal fill-in product, because sheet-metal parts can be made from scrap left from production of air conditioning units and space heaters. In the distribution end, more than 40,000 gaslights have been installed in less than two years. Moreover, Arkla believes that this represents only a start, and that gaslights will gain more and more acceptance in many fields.

Patents

How Manufacturers Look at Outside Ideas. E. R. Cunningham. Part 1. *Design News 15,* 14 (1960) Feb. 1 (2 pp.); Part 2. *Ibid.,* 26 (1960) Feb. 15 (2 pp.)

Part 1 presents the results of a recent questionnaire sent to 1000 engineering executives on the factors involved in submission and purchase of outside design ideas. These factors include number of employees in design work, department which handles ideas submitted, who negotiates for idea purchase, time needed to market, patent agreement policy, and outside ideas acquired in five years. Part 2 discusses answers to questionnaires to selected independent inventors (chiefly in mechanical design) on the number of patents held, number assigned, submission practice, time to develop, guidance in marketing, and cost of patents.

Petroleum

Oil Companies Win Their Case. *Business Week, 36* (1960) Feb. 20.

Twenty-nine oil companies charged by the government with criminal conspiracy to fix the prices of crude oil and automotive gasoline were acquitted and vindicated in the U. S. District Court in Tulsa, Okla. last week. Judge Royce H. Savage ruled that not only was the first price increase justified, but that the other companies had no choice but to follow. For the oil companies, dismissal of the Tulsa case ends their troubles with the antitrusters—at least on the post-Suez price increase. While jubilant over their vindication, they are irked that the government ever started the case.

Ratemaking

Gas Rate Fundamentals. New York: American Gas Association, 1960, $7.00 (357 pp.)

This book, sponsored by the Rate Committee of the A.G.A., is presented as a reference work on gas rate fundamentals and practices. It comprises a collection of papers especially prepared by rate men in various segments of the gas industry. Despite the "dry" implications of the title, the book presents an interesting and clear account of the gas utility industry and its relations with its customers. The history, production, economics, and future of gas are discussed in the first section consisting of six chapters. Growth, organization, and guid-

ing decisions of public utility regulation comprise the second section of four chapters. Cost of service, pricing of service and rate forms are discussed in eight chapters in which elements entering the cost such as loads, sampling, major components, study procedures, pricing factors, rate types and classes, and pipeline rates are included. Sections five and six outline the statistical analyses of income, load forecasting, block consumption and rates and operation of rate department. Section seven presents the procedures before regulatory commissions, in which preparation of certificates, forms, and applications, and the presentation of cases are outlined.

Research

Process Research. T. J. Williams. *Chem. Eng. 67,* 131 (1960) March 7 (6 pp.)

Article lists steps which should result in close working cooperation of chemical research and systems engineering personnel and best use of computer aids in determining reaction mechanism and kinetic models of processes: 1) summarize available knowledge of the reaction, including a thorough literature search; 2) outline a series of experiments for elucidating areas where knowledge is incomplete; 3) determine the conditions which the reaction mechanism must fulfill; 4) write down chemical and mathematical relationships governing each possible mechanism; 5) procure additional experimental data if needed; and 6) by computer analysis, determine best values of kinetic coefficients for each of the reaction mechanisms which still appear possible.

2. ENERGY SUPPLY AND ECONOMICS

Competitive Fuels

Friend or Foe? Coal Doesn't Know. *Oil Gas J. 58,* 62 (1960) Feb. 15 (2 pp.)

Newly-reorganized National Coal Assoc. considers itself at the crossroads. It can follow the route leading to aggressive drives for legislation, or it can follow a course of more cooperation between the industries in a "live and let live" atmosphere. Association's leaders say they prefer the second course. But they make it clear that they will fight, if need be, for competitive survival.

Our Competitive Position in Relation to Oil Heating. C. C. Turner. *LP-Gas 20,* 38 (1960) Feb. (5 pp.)

Advantages that LPG offers over oil: more dependable, safer, cleaner, requires less servicing, less noisy, simpler to operate, and maintains desired temperatures within closer limits. Article shows how to compare incidental (installation, depreciation, cleaning and service) costs of LPG and oil heating for each customer. Extra cost of oil is divided by the number of gallons customer uses in a year to find the extra cost/gal. This, when added to the price of oil/gal, is more than the equivalent cost/gal of LPG.

Will Gas "Freeze Out" Oil Heat? *Petrol. Week 10,* 15 (1960) Feb. 19 (2 pp.)

A composite forecast shows that oil heat marketers expect to pick up 2.2-million additional customers by 1969, after losses by conversions, while gas utilities predict they will add a whopping 14-million users of gas heat. Article points out that gas utilities have plans to capture the lion's share of new customers, plus an increasing number of conversion from oil. Heating oil marketers, on the other hand, lack a coordinated promotional plan, and have yet to develop a really good burner.

Electricity

What Others Think. *Public Util. Fortnightly 65,* 259 (1960) Feb. 18 (9 pp.)

The Edison Electric Inst. recently submitted a 55-page report to the Select Committee on National Water Resources, which wanted to know more about anticipated water requirements of the electric utility industry between 1959 and 1980. Information was also requested on future electric energy demands and capacity requirements. Answers were given under the following headings: 1) peak load, capability, and energy requirement forecasts; 2) production costs of representative conventional thermal plants; 3) nuclear power; 4) hydro development; and 5) water requirements for thermal plants. Tables are presented which contain projections for the total electric industry in terms of generation, use per capita, peak loads and energy requirements, and type of generation employed.

Steam-Electric Power Costs—1954 to 1958. H. E. Roberts. *Combustion 21,* 26 (1960) Feb. (11 pp.)

Electric power industry's net increase in total generating capacity during the five years, 1953 through 1958, was a remarkable 55%. For the 48 states, public and privately owned class utilities had an installed capacity of 113,040 megawatts thermal, and 29,363 megawatts hydroelectric power. Charts and tables presented give data from 1940-58 for the number of steam-electric plants, total plant capacity, cost per installed kw, and increase in plant size. Costs of power are discussed from standpoint of components of total production, regional variation, fuel costs (including coal, natural gas and oil), plant thermal efficiencies, automation, nuclear power, and the future.

Energy Sources

Towards a New Energy Pattern in Europe. Energy Advisory Commission of the O.E.E.C. *Gas World 151,* 282 (1960) Feb. 13 (4 pp.)

Prospective energy requirements and supplies of Western Europe are reviewed in this recently issued report. The independent experts making up the Commission also consider in detail the economic, financial and political problems involved in future developments in the field of energy. Estimates of total consumption in the OEEC area show that consumption of gas, derived both from natural sources and from manufacture has been rising almost as fast as the consumption of electricity and has increased by an average of 7% per year between 1950 and 1957. Total primary energy demand of the

area is expected to increase by 25-30% between 1955 and 1956, and by 58-83% between 1955 and 1975.

Fuel Cells

Conversion of Heat into Work. Some Thermodynamic Aspects. A. V. Brancker. Part 1. *Petroleum 23,* 56 (1960) Feb. (4 pp.); Part 2. *Ibid.,* 105 (1960) March (5 pp.)

A description is given of the more fundamental or thermodynamic aspects of so-called direct conversion processes, such as the fuel cells and H_2-CO-O_2 cells where gaseous products for hydrocarbons or coal can be used. First law of thermodynamics is discussed. Equations are given which illustrate the conversion of energy in nonflow and flow systems. Flow cycle diagram of a simple heat engine is illustrated. Concept of available and unavailable energy is presented, and the term entropy index is defined. Concluding article presents author's study of thermodynamic aspects of the direct conversion of heat into electrical energy. Although efficiencies of as high as 70% have been claimed for direct conversion processes using fuel cells, there are still several causes of inefficiency. The most ideal cell would be one which converts heat from an external source directly into electricity.

Heat Pump

Heat Storage for Residential Heat Pumps: A State-of-the Art Study. J. A. Eibling, D. W. Locklin, and J. W. Droege. Paper CP 60-317. New York: Amer. Inst. Elec. Eng., 1960 (17 pp.)

Paper contains a discussion of the application of heat storage to residential heat pumps, with emphasis on methods of heat storage that appear to offer promise for further development. Only heat storage for use with heating-cycle operation is treated. Of the several systems considered, high-temperature storage charged with resistance heating during off-peak hours offers the most immediate promise. Second choice is condenser-side storage charged by the heat pumped.

Nuclear Energy

An Indirect-Cycle Nuclear-Reactor System to Furnish Process Heat-Engineering and Design Concepts. R. C. Dalzell and J. P. McGee. *U.S. Bur. Mines Inf. Circ. 7920.* Pittsburgh: The Bureau, 1959 (16 pp.)

Conceptual design of a nuclear reactor to furnish process heat for coal gasification has been made. Spherical fuel elements utilizing a graphite structure impregnated with uranium carbide fuel were chosen, as spheres offer the possibility of easier loading and unloading of the reactor. Calculations of pressure drop and gas-pumping power for the system are included. A study of the design criteria and possible materials of construction for the heat exchanger (coal gasifier) was conducted. Conditions of operation of the recycle compressor to circulate the helium through the system were reviewed. Although such a machine is not currently available, experience with gas turbines operating at even higher temperatures should be applicable. Pressures, temperatures, and heat duty for a projected commercial system to gasify 120,000 lb of coal per hour were calculated. To gasify this quantity of coal would require one 250-thermal-megawatt reactor, the size chosen for this design study.

Oil Shale

Pilot-Plant Operation of Gas-Flow Oil-Shale Retort. V. Kalcevic and J. D. Lankford. *U.S. Bur. Mines Rep. Invest. 5507.* Pittsburgh: The Bureau, 1959 (34 pp.)

A gas-flow retort for thermal processing of oil shale to recover shale oil was developed by the Bureau from 1948 to 1952. Retort is a crossflow gas-to-broken-solids heat exchanger. Heating medium is the gas produced in the shale retorting process. The gas is heated in specially designed stoves outside the retort and recycled to the retort. Indicated maximum oil recoveries for 20 to 25-gal/ton shale in a 12-in. thick shale bed and a 20-in. bed are 96 and 91 weight percent of Fischer assay, respectively. Heat requirements for maximum recovery are 600-750 Btu/lb of shale. Properties of the recovered shale oil are affected slightly by shale-bed thickness and extent of retorting. Oil recovery from oil shales assaying over 30 gal/ton is lower than that from leaner shales. Retort heat-transfer mechanism, although continuous, is equivalent to a gas-to-broken-solids batch system.

Petroleum Reserves

Size of Crude Reserves Is Key to Evaluating Exploration Programs. J. R. Arrington. *Oil Gas J. 58,* 130 (1960) Feb. 29.

Exploration costs can usually be determined, but the problem is to decide how much oil was actually discovered. Article gives Carter Oil Co.'s method of developing current reserve estimates into dependable future reserve figures. It is shown how the adjustment factors can be developed and some of their uses are illustrated. Probable final factors shown are applicable only to Carter's reserve statistics, because they are a function of the manner and rate in which Carter's personnel estimate reserves. However, the principle can be applied to any set of reserve data which groups reserves by year of discovery.

Shale Oil

Situ Recovery for Carbonaceous Deposits. F. Ljungstrom. (assigned one-half to Svenska Skifferolje A. G., Sweden and one-half to Husky Oil Co.) U. S. 2,923,535 (1960) Feb. 2.

In this process, electrical resistance heaters are lowered in cased wellbores to preheat impermeable carbonaceous (coal or shale) strata whereby moisture is driven out, and the then permeable strata are injected with air or oxygen under pressure to raise temperature to gasification and/or distillation range. This preheating and blasting may be operated over an advancing front, while the valuable gas or distillation product is withdrawn from wells in the dried strata.

Solar Energy

Japan Applies Solar Energy. J. I. Yellott. *Mech. Eng. 82,* 49 (1960) March (4 pp.)
Most of the future fuel requirements for Japan's 90,000,000 people and highly industrialized economy will have to be imported. Coal reserves are limited in quantity and low in quality. There is no indigenous oil or natural gas, but the automobile population is already large, and imported petroleum is playing an increasingly important part in the economy. Article discusses research done by the Solar Energy Application Committee of the Japan Society of Mechanical Engineers to develop simple and economical equipment which will enable the sun's radiation to supply a substantial part of the nation's low-temperature heat requirements.

To Practical Solar Heat. H. E. Voegeli. *ASHRAE J. 2,* 68 (1960) March (3 pp.)
Author discusses theoretical design of solar residental heating. Reflective conical collectors with temperatures of 400-500°F would absorb the sun's rays. Heat collected in this manner is stored in tanks of water underground for heating when winter comes. Stored heat is augmented in winter by use of a heat pump.

Tar Sands

Oil Recovery from Bituminous Sand. R. J. Stegemeier and P. W. Fischer (assigned to Union Oil Co.) U.S. 2,924,565 (1960) Feb. 9.
A process for recovery of hydrocarbons from natural tar sands is claimed in which the raw sand is pulped in a sloped rotary beater with 1-1.5 bbl/ton aqueous sodium silicate solution of high basicity (above 0.4) and a diluent hydrocarbon at about 180°F. The hot pulp drains to a primary separator in which sloped baffle screens tumble the sand and permit disengagement of oil. The separator liquid is passed to a thickener, in which silt is settled out and oil separates as an upper layer while the aqueous layer is recirculated.

Treatment of Bituminous Sands. R. P. Vaell and P. W. Fischer (assigned to Union Oil Co.) U.S. 2,924,566 (1960) Feb. 9.
In a tar sand treatment process for recovery of hydrocarbons by pulping the sand with oil diluent and aqueous sodium silicate, the primary separator for the pulped sand is improved by forming the baffles into alternate conical primary and inverted truncated secondary forms. Primary baffles have serrated lower peripheries, to aid in spreading the upward flow of a agitating fluid, and are provided with apical oil-collecting conduits opening upward at the next baffle.

Thermoelectricity

Constant Temperature Apparatus. W. R. Danielson and C. R. Lopp (assigned to Whirlpool Corp.) U. S. 2,922,284 (1960) Jan. 26.
A means for heating and maintaining a liquid bath at constant temperature is claimed, in which the liquid receptacle is heated by closely contacting walls formed of thermoelectric couples using the Peltier effect. Current direction is controlled by a thermocouple regulator, to give a hot or cold junction at the inner wall.

3. NATURAL GAS AND PETROLEUM PRODUCTION

Air Drilling

Foaming Agents Spur Use of Air Drilling. W. C. Goins, Jr. and H. J. Magner. *Drilling 21,* 65 (1960) Feb. (3 pp.)
Use of foam producing agents to effect removal of cuttings and water at operable pressures has extended the benefits of air drilling to include wells with water flows of up to 200 bbl/hour. Agents which perform best are nonionic foamers. These perform well in the presence of salty formation waters and are not strongly absorbed by cuttings. Greatest determents to wider use of foam drilling are sloughing shale and water disposal.

Drilling

Basic Changes Needed for Turbodrills. *Petrol. Week 10,* 34 (1960) March 4 (3 pp.)
Basic research in bit design and significant changes in turbodrills should be made before further field-testing of turbodrilling can be recommended. Current turbodrill equipment, bits and techniques have been adequately tested already under drilling and economic conditions. Major problem that has prevented turbodrill success to date—poor bit performance—might be best attacked by designing a downhole tool to fit current bit design, rather than vice-versa.

How to Drill 10,000 Feet in Four Days and 22 Hours. V. C. Stone. *World Oil 150,* 72 (1960) March (3 pp.)
Gulf Oil Corp. recently drilled an offshore well from spud to 10,000 ft in four days, 22 hours. Several new ideas of present drilling practices were used, which were responsible for the improved overall performance. These practices include: 1) maximum efficient hydraulic program; 2) exceptionally high bit weights; 3) exceptionally fast rotary speeds; 4) decreasing waiting on cement time; 5) eliminating slope tests; 6) eliminating reaming; and 7) keeping sand content very low.

What Weight and Speed Produce the Lowest Drilling Costs? E. McGhee. *Oil Gas J. 58,* 84 (1960) March 7 (4 pp.)
Field tests now under way have greatly reduced drilling times without adding any new equipment to the rig. New advances are the result of picking bit weights and rotary speeds on the basis of scientific fact rather than on personal experience. Mathematical expressions have been developed by a tool company for 1) drilling rate of a rock bit; 2) rate of wear of rock-bit teeth; and 3) rate of rock-bit bearing wear. Methods are estimated to cut 10% from drilling cost of the average U.S. well.

Drilling Mud

Drilling Fluids: A Current Review. G. K. Jones. Part 1. *Petroleum 23,* 43 (1960) Feb. (5 pp.); Part 2. *Ibid.,* 101 (1960) March (4 pp.)

Part 1 discusses functions and properties required of drilling fluids. A general purpose drilling mud can be made from water, clay, and ground barytes, or other chemicals. Properties of the mud are determined by the physical and colloidal behavior of the clay/water suspension. Course taken by the drilling fluid in a modern rotary rig is illustrated. A table is given of 14 of the more common chemicals used. Part 2 gives examples of specialized fluids, together with an account of field testing procedures.

High-Calcium Drilling Fluid Represses Clay Hydration. P. H. Monaghan and J. L. Gidley. *Drilling 21,* 70 (1960) Feb. (3 pp.)

Four field tests using high-calcium mud were conducted in a South Louisiana area noted for shale problems. A mud containing between 3000 and 4000 ppm of calcium ion gave satisfactory performance under field operating conditions. High-calcium mud possessed good stability and appeared to reduce the hydration and dispersion of drilled bentonic shales. It reduced viscosity buildup, and gave some reduction in bore-hole enlargement. Apparent increases in penetration rates were observed when the high calcium mud was used, but further field testing is needed before a positive statement can be made about the effect of the mud on drilling rate.

Use of Inverted-Emulsion Mud Proves Successful in Zones Susceptible to Water Damage. G. A. Trimble and M. D. Nelson, Jr. *J. Petrol. Tech. 12,* 23 (1960) Feb. (8 pp.)

In Central Oklahoma, completion or workover of oil wells using a water-base drilling fluid has not been satisfactory. This is particularly true in sands of Pennsylvanian age. During the past six years, Mobil Oil Co. has employed an inverted-emulsion mud in more than 150 separate operations with outstanding success. These operations have included drilling into producing formations, well completions and workovers. Principal advantages observed for this mud system include 1) less damage to formation productivity, 2) more positive and quicker formation evaluation, 3) quick and easy well completions and 4) effectiveness as a workover mud. Advantages accrue because freshly exposed producing formations or new flow channels into undamaged formations are protected from contact with an aqueous fluid.

Exploration

Many Operators Entering Appalachian Basin. H. T. Brundage. *World Oil 150,* 93 (1960) March (7 pp.)

There seems to be no question that many oil and gas fields in the Appalachian Basin have been missed in previous drilling in times prior to modern logging, formation fracturing, acidizing, and other methods. This is not only true of the Appalachian province. Technique, however, stands to benefit the Appalachian province more than any other in the U. S., because in almost all Appalachian productive formations, low permeability is a factor and a problem.

Geology

Higher Standards for Geologists Urged. *Oil Gas J. 58,* 68 (1960) Feb. 22 (2 pp.)

A new professional organization is in the making which would police the geological and related professions. It would have a stiff code of ethics and membership requirements which would help identify and protect qualified geologists. This new association would replace the American Geological Institute and include all earth scientists. It would draw many members from the AAPG, SEG, AIME, and other oil groups.

Isthmus of Tehauntepec. R. Gill and L. A. Yzaguirre. Part 1. *Oil Gas J. 58,* 159 (1960) Feb. 15 (4 pp.); Part 2. *Ibid.,* 150 (1960) Feb. 22 (6 pp.)

Authors present a geology report of the Mexican oil-producing zone located in the northern part of the Isthmus of Tehuantepec, on the Gulf of Mexico. The salt-bearing formations, especially the dome structure, which formed in the Triassic are described. These make up the Saline, Macuspana and Mecoacan Basins which are located across southern Mexico and have been very productive.

Logging

A New Nuclear Log for the Determination of Reservoir Salinity. S. G. Stroud and H. E. Schaller. *J. Petrol. Tech. 12,* 37 (1960) Feb. (5 pp.)

A new approach has been developed for the determination of salt in the formation from both a qualitative and quantitative standpoint. The principle has been substantiated by laboratory-type tests, and charts have been developed which permit the calculation of salt-water saturation for certain borehole conditions. Field experience has been encouraging and indicates an increasing application for this service, particularly in evaluating zones and intervals subsequent to the initial producing phase of a well. With the development of a through-tubing tool of this type, even broader applications seemed assured for the industry.

Offshore Operations

Floating Drilling-Barge Operations. K. M. Nicolson. *J. Petrol Tech. 12,* 18 (1960) Feb. (5 pp.)

Application of floating-barge drilling has been restricted in the past while equipment development was progressing. Outlook for the future, however, is quite broad. Present stage of development favors exploratory drilling where probability of completion is small. As completion and production techniques are improved, development drilling will become more attractive. Applications will be most favorable for conditions which are expensive with conventional equipment such as deep water or very soft bottom. Inherent economy of the floating-barge method will also bring this equipment into competition with methods in shallow water.

Government May Take Control of Offshore Oil Production. *Oil Gas J. 58,* 64 (1960) Feb. 22 (2 pp.)

U. S. Geological Survey is now studying conservation rules to govern offshore operations. It will probably not take over unless it becomes dissatisfied with state-fixed allowables or if it inherits oil through the Supreme Court boundary ruling expected this spring. Basic fear among oil men is that any federal move to prorate offshore will be an opening wedge for more encroachments into the oil business.

Offshore Operators Gear for Decade of Steady Growth, Big Changes. *Petrol. Week 10,* 40 (1960) Feb. 19 (15 pp.)

Special report discusses offshore outlook for the next decade. Outcome of upcoming federal lease sale of 1.6 million acres of submerged tracts off Louisiana and Texas will be an index of overall interest in the province. Other indications point to steady growth and big operating changes including: increase use of mobiles, and new floating drilling concepts; development of standard, effective underwater completion systems; construction of a true underwater storage facility; and new gains in safety and automation.

Phillips Is Sharing Offshore Costs. *Oil Gas J. 58,* 41 (1960) Feb. 29.

Phillips Petroleum Co. has taken in Ocean Drilling & Exploration Co., New Orleans, as a partner in another batch of its Louisiana offshore properties. Agreement involves properties covering 3800 acres in Eugene Island Area, containing two producing platforms and ten wells. Six of the wells produce about 600 bbl/day of crude oil, and 1500 MCF/day of gas. Phillips made agreement in order to share the heavy costs of drilling and developing its offshore holdings.

Petroleum Production

A Review of the Enriched Gas Drive Process. D. M. Kehn. *Producers Monthly 29,* 28 (1960) Feb. (6 pp.)

In water flooding or gas injection, the most efficient use of the displacing fluid still results in a sizeable fraction of oil being left in the ground. Injection of natural gas enriched with light hydrocarbons has been used to recover this remaining oil. Article reviews the physical concepts of enriched gas drive, and discusses factors which should be considered in engineering such a project. Latest information on enriched-gas drive projects in the industry is summarized.

Reservoir Engineering

Application of Buckley-Leverett Techniques in Oil-Reservoir Analysis. R. V. Higgins. *U. S. Bur. Mines Rep. Invest 5568.* Pittsburgh: The Bureau, 1960 (21 pp.)

As part of a study of application of the Buckley-Leverett method an analysis of oil-reservoir performance covering a wide range of relative permeabilities and oil saturations, a method has been devised for quickly determining average water saturation at breakthrough from relative permeability data. Base for the relative permeability used in the report is either the permeability to air or the effective permeability to oil at the irreducible water saturation. Permeability to air also was used because of the large backlog of air permeabilities available to reservoir engineers. Basic data were calculated by computer and are presented in a graph from which the point of breakthrough may be obtained. Water saturation at the beginning of the depletion is the connate or interstitial or irreducible water saturation. Analysis of computer data also showed that it is possible to obtain an approximate engineering valuation of preferential wettability of a core oil or water.

Bottom-Water and Edge-Water Effects on Low Gravity Oil Production. C. R. Knopp. *J. Petrol. Tech 12,* 45 (1960) Feb. (7 pp.)

The mechanism of selective encroachment, which apparently occurred along thin, highly permeable stratum, acted to substantially reduce ultimate recovery in the four reservoirs studied from 7%—if solution drive were the depletion mechanism. Two basic remedial techniques offer a possible solution for eliminating adverse edge-water encroachment: 1) gas pressure maintenance, and 2) water production from the more down-dip area of the reservoir with a view to obtaining a balance with water influx from the associated aquifer.

CO_2 Scores Highest in Reducing Oil Viscosity. L. R. Dickerson and G. W. Crawford. *Oil Gas J. 58,* 96 (1960) Feb. 22 (3 pp.)

Production of viscous crude may be made more efficient by injection of certain gases that have a marked effect on crude viscosity and density. Laboratory studies show which gases are most effective at various concentrations and temperatures. At normal reservoir temperatures, 125° F and above, CO_2's effectiveness is equal to or greater than the influence of either methane or ethane, and is retained in solution for a longer period of time after pressure reduction than are either of these two gases. However, of the gases tested, methane and ethane are the most effective below 80° F.

How to Obtain and Compare k_w/k_o Curves from Steady-State and Laboratory Unsteady-State Flow Meaurements. E. T. Guerrero and F. M. Stewart. *Oil Gas J. 58,* 104 (1960) Feb. 22 (3 pp.)

Given steady and unsteady-state water and oil relative-permeability data for the same core, article finds the variation of water-oil permeability rotations, k_w/k_o, with water saturation by both steady-state and unsteady-state methods.

Methods for Determining Water Contents of Oil-Bearing Formations. W. H. Caraway and G. L. Gates. *U.S. Bur. Mines Rep. Invest. 5451.* Washington: Govt. Printing Office, 1959, $0.50 (81 pp.)

Report presents the results of an evaluation of several indirect methods of measuring water content of oil-reservoir rocks. Water content of oil-base cores is considered to be most nearly representative of the water content of the undisturbed petroleum reservoir and therefore, the direct method of measuring the volumes of water in cores cut in oil-base drilling fluid

was adopted as a standard for comparison. Indirect methods evaluated included 1) displacement through a semipermeable membrane by air, 2) centrifuge, 3) evaporation, 4) mercury injection, 5) chloride dilution, and 6) electric logs.

Two Bottom-Hole Pressure Instruments Providing Automatic Surface Recording. Tech. Note 2055. R. H. Kolb. *J. Petrol. Tech. 12,* 79 (1960) Feb. (4 pp.)

Special-purpose instruments are described which provide pressure more conveniently, accurately, or quickly than is possible with conventional equipment. In addition to providing surface recording and protracted uninterrupted operation, the cable-operated Maihak transmitter also provides a precision and accuracy of both time and pressure measurement that are not available elsewhere. The automatic recorder for use with the Maihak transmitter is a conveniently portable and adequately accurate device suitable for more routine applications.

Well Practice

Implosions Improve Well Injectivity. D. D. Setser and J. P. Moran. *Oil Gas J. 58,* 92 (1960) March (2 pp.); *World Oil 150,* 100 (1960) March (4 pp.)

New methods help wells accept acid and other stimulating fluids. Implosion technique opens the way for successful fracturing of hard-to-fracture formations. Methods consists of lowering an implosion capsule or capsules into a well to the depth where selective stimulation is desired. Pressure is applied to the capsule through the surrounding fluid medium until the capsule collapses and an implosion takes place. Equalization of pressures in the space previously occupied by the capsule creates shock waves which strongly affect the formation immediately adjacent to the imploding capsule.

4. GAS CONDITIONING AND LPG RECOVERY

Condensate Removal

The Indirect Line Heater. J. W. Dorsey. *World Oil 150,* 59 (1960) March (4 pp.)

Basic parts of the indirect heater for preventing hydrate formation are the flow coil, firebox and shell. Heater is normally a horizontal vessel mounted on steel saddles or skids. Water is used to transfer heat from the firebox to the flow coil. Heating tube is mounted in the lower segment of the vessel and the coil in the upper portion. Specific applications include: 1) installation on the flow line upstream of the pressure reducing choke on low-temperature separation units; 2) use in conventional stage separation hookups; 3) installation upstream of short cycle hydrocarbon recovery units to maintain constant inlet gas temperatures; and 4) upstream usage with glycol dehydration units. Heat transfer data and examples of design calculation are given.

Dust

Apparatus for Separating Dust from Gas, Particularly Hot Gas. W. O. H. Kroll (assigned to Klockner-Humboldt-Deutz A. G., Germany) U. S. 2,925,144 (1960) Feb. 16.

An improved device for mechanical removal of dust from hot gases is claimed comprising two vertically placed constricted zones in branches of a high-velocty gas channel; each zone containing a filter composed of multiple parallel grids of wires, spaced apart and distributed over entire cross section of zone, with a sliding scraper arranged to clear the impinged dust from wires of each plane of the grid assembly.

Hydrogen Sulfide Removal

Purification of Coke Oven Gas in Tower Purifiers. J. V. Burgess and J. Codman. *Gas World 151,* 17 (1960) Feb. 6 (5 pp.)

Purification plant at Manvers, England was first put in operation in November, 1956 and was designed to purify some 22 million CF/day with provision for further expansion if required. Main factors of the operation of the tower purifiers are discussed, including: operation control, changing and rotation of towers; control of moisture, temperature, admission of air, and pH; and regeneration of H_2S. Authors discuss three main aims of purification practice: 1) effective removal of H_2S; 2) production of a spent material with a high sulfur content and with a minimum number of foulings; and 3) operation with a minimum of trouble.

Theoretical Basis of Dry Sulfur Removal from Gas. P. Michaelis. *Gas u. Wasserfach 101,* 97 (1960) Jan. 29 (6 pp German text).

In technical and economic results of dry gas purification with air addition to crude gas, the H_2S absorption is not decided by purification mass and its regeneration but by removal of sulfur from gas and by mass enrichment. Sulfur removal is explained as a catalytic oxidation of H_2S in the gas phase. Equilibrium of this conversion is determined by the activity of the purification mass, the molecular concentration of reactants, and the reaction pressure. Exothermic character of the conversion permits only a limited reverse reaction, which results from falling mass activity because of mass enrichment. The continuous reduction of mass activity limits the completion of desulfurization and enrichment in the initial purification step; this is assumed from the observation of a "critical sulfur content" of the mass in the final purification stage. Both requirements, namely gas purification and mass enrichment, are fulfilled successfully only by application of counter-current flow principles in maintaining a sufficient "sulfur concentration drop" in the installed mass. Equations, capacities, and sample calculations using operating results are given.

Nitrogen Oxides

Process of Removing Nitrogen Oxides from Gas Streams of Varying Composition. R. E. Reitmeier (assigned to Chemetron Corp.) U. S. 2,924,504 (1960) Feb. 9.

Nitrogen oxides, such as in tail gases of nitric acid plants, are removed from a gas mixture by reducing to nitrogen. Iron, cobalt, nickel, and copper catalysts dispersed on refractory alumina granules are maintained in

a bed at 500°-1000° F, by a natural gas-air flame if needed. The tail gases with added excess H_2, CO and hydrocarbon gases are passed through at a space velocity of 10,000-20,000.

5. NATURAL GAS TRANSMISSION

Automation

Eyeing Automatic Pipeline Control? G. Post. *Oil Gas J. 58,* 94 (1960) March 7 (3 pp.)

Savings can be achieved if a control system is designed to adapt easily at low cost to changes which can occur in pipeline-control requirements in the first 5-10 years of operation. These changes include elements due to population growth and urban expansion, growing applications of the newly available products, and tie-in with other lines into more integrated systems. If the pipeline system does not have these types of near-future requirements, automatic expense has little economic justification.

Compressors

Adiabatic Head Selects Compressor Type. W. A. Spraker and R. A. Stein. *Prod. Eng. 31,* 46 (1960) March 7 (5 pp.)

Article develops adiabatic-head equation which is used in selecting a small compressor (1000 CF/min.) Knowing the pressure ratio, required flow and shaft speed, the adiabatic head concept leads to the choice between a positive-displacement and centrifugal compressor.

Two Stage Centrifugal Pipeline Compressor. E. W. Tanzberger and H. O. Jacobi. *Pipe Line News 32,* 34 (1960) Feb. (5 pp.)

Compression ratios for single-stage centrifugal compressors have steadily increased to values which are approaching limitations relative to mechanical and hydraulic design criteria. Article outlines some of these considerations with respect to actual requirements and applications. At the present time, a number of multi-stage units are successfully operating on domestic gas-transmission lines.

Corrosion

Planning the Corrosion Control Program. *Pipe Line Ind. 12,* 24 (1960) March (8 pp.)

Article presents Texas Eastern's highly efficient corrosion control program which is an integrated part of a general instrumentation department. Main idea is to combine corrosion control with other instrumentation functions such as measurement. On a long transmission system, a field engineer whose only duties are to handle corrosion problems, must be assigned to a widely spread territory, and a very large portion of his day is spent going to and from work locations. However, were this engineer able to have diversified duties, such as handling corrosion control, gas measurement, quality control and possibly communications in addition to servicing the instruments used by the other departments of the company, his accomplishments would be greatly increased.

Engines

Supercharging Existing Two-Cycle Gas Engines. *Gas Age 125,* 33 (1960) March 3 (6 pp.)

Authors describe five methods used to supercharge two-cycle gas engines. Each method is economic for certain installations, depending on fuel requirements, how long the extra horsepower is to be used, and parasitic load on the engine. Parallel and series turbocharging are two methods emphasized.

Fluid Flow

A Universal Instrument for Research into Turbulence in Nonsteady Gas Flows. A. M. Khazen. *Sb. Statei Nauchn. Stud. O-va Mosk. Energ. In-ta,* 53 (1957) No. 10 (13 pp. Russian text); [From *Appl. Mech. Rev. 13,* 198 (1960) March.]

A description is given of an installation for measuring the intensity of turbulence by glow discharge. Although glow discharge has more than once been suggested for the measurement of turbulence, it has not been used up to the present owing to the insufficient stability of its characteristics. The theory of the instrument and the selection of the discharge stability conditions are given. The instrument constructed by the author consists of a 6 mm diameter glass rod; the working section of the sonde is 3-5 mm long and 1 mm wide; the frequency range is 2-100 kc/s. Measurements can be made by oscillograph and by thermo-amperemeter (for measuring the root-mean-square velocity pulsations). In order to investigate the rotary break away and the coefficient of correlation of the turbulence components of the velocity at two points, the instrument is made in two-channel form. Pulsation oscillograms taken with this instrument in various flows are given. The instrument is of small dimensions and is characterized by its universal applicability; it is suitable for many aerodynamic experiments, and in the author's opinion is about twenty times cheaper than a thermo-amperemeter with the same frequency range.

E. M. Minskii

Courtesy Referativnyi Zhurnal, USSR
Translation, courtesy Ministry of Supply, England.

Gas Turbines

Why a Jet Gas Turbine? R. L. Boyer. *Pipeline Eng. 32,* D-42 (1960) March (2 pp.)

An extensive study of the gas turbine as the potential competitor to reciprocating engines and compressors has been made. Conclusion reached is that the gas turbine in some form is here to stay. However, gas turbine efficiency, in its highest form, still falls far short of the most efficient reciprocating engines. Article describes details and purpose behind an experimental unit now being installed on Columbia Gas Transmission Co.'s system.

Pipeline Construction

More Capacity for Your Pipeline Dollar. G. Kinney. *Oil Gas J. 58,* 135 (1960) March 14 (5 pp.)

An *Oil Gas* survey reflects concern that inflation may threaten expansion in the gas industry. Replies from pipeliners and manufacturers of pipe and compressor machinery show steps are being taken to maintain low unit transportation costs. Pipe manufacturers are coming out with higher-strength pipe. Equipment manufacturers are designing gas turbine drive centrifugal compressors with much lower first cost, and standard compressor units which have increased power, efficiency, and automation. Transmission firms are using new high-strength, thin-wall pipe; construction methods are being adopted which cut costs. Entire emphasis is toward more capacity per ton of steel.

Pemex Builds a City . . . and a Gas System. A. Berumen. *Gas 36,* 144 (1960) March (4 pp.)

Currently under construction in Mexico is a 24-inch pipeline which will bring natural gas from the Jose Colomo field to Mexico City. Use of this gas will allow large volumes of fuel oil to be used as cracking stock in refineries. Permanent installations for the Pemex operations include an absorption plant, power plant, boiler house, water pumping station from the Chilapilla river, settling pond, and treating facilities. Final pressure on the main gas lines to the plant is 2000 psig at the stations, dropping to 1800 psig at the plant inlet. Five 2000-hp engines handle the 250 MMCF/day of plant discharge gas boosting the pressure to 3900 psig and returning it to the reservoir.

SOPEG's 24-in. Crude Line Crosses French Sahara. *Pipeline Eng. 32,* D-33 (1960) March (5 pp.)

In the Algeria/Sahara Desert of North Africa, a determined French pipeline company is pushing a 24-in. line from the Hassi-Messaoud field 410 miles northward to the port of Bougie on the Mediterranean Coast. First stage of the $106 million pipeline is now flowing 100,000 bbl/day; ultimate capacity by 1961 is 300,000 bbl-/day. Also under construction is a 24-in. gas line from a field northwest of Hassi-R-Mel to the Mediterranean coastal city of Oran, which will also tee over with a 16-in. line to Algiers. Primary purpose: to supply needed fuel for industrial development of these two major port cities.

1960's Biggest Pipeline Uses X-56 Pipe for Entire Main Line. *Oil Gas J. 58,* 142 (1960) March 14 (7 pp.)

Transwestern Pipeline Co. has made extensive use of the high-yield X-56 pipe introduced into the industry in the last two years. In the first two months of construction, experience showed that methods for welding and bending are the same for X-56 as for X-52 pipe. Winter construction requires preheating for welding and defrosting before coating. Eighty-foot joints are used for the first time in the mountainous terrain.

Pipeline Operations

Better Controls, More Automatic Operation, Pace Progress of Natural Gas. T. C. Heard. *Oil Gas J. 58,* 121 (1960) March 14 (13 pp.)

Sizes of gathering, treating, transporting, distributing, and storing facilities are now so large that more efficient and rapid means of control of the gas-handling equipment is necessary. Time constants of the newer, more efficient equipment are short so that automatic protection and control is inherently a requirement for use of this equipment. Installed cost of basic equipment and its operating costs have increased considerably, and more efficient use of the equipment is the only way to operate profitably. Modern controls are discussed for major types of driver-compressor combinations.

Spherical Pigging. *Gas Age 125,* 21 (1960) Feb. 18 (5 pp.); **Batching Two-Phase Flow with Spheroids.** T. W. Bean and H. N. Eagleton. *Pipe Line Ind. 12,* 47 (1960) March (5 pp.)

Colorado Interstate Gas Co. solved its problem of condensation of heavy liquids as gas moved from wells in the Oklahoma panhandle by inserting inflated neoprene spheres in the 40-mile gas line. The spheres, propelled by pressure of the gas behind them, push out the heavy hydrocarbon liquids lying in front.

Welding

Big Pipe Will Be High-Speed Welded. *Petrol. Week 10,* 76 (1960) Feb. 19 (2 pp.)

High-frequency electrical resistance welding, a cost-cutting method already used to make small-diameter pipe, will be used for the first time in fabrication of pipe up to 36-in. by Big Inch Pipe Corp. of Calgary. Welding process is estimated to cut labor costs to one-third the amount needed to make pipe by other methods. High-frequency electrical resistance is faster because it heats only the edges to be joined, and very little of the surrounding pipe area.

6. GAS AND LPG STORAGE

Gas Holders

Commissioning a Large Gasholder. M. J. P. Le Cornu. *Gas World 151,* 289 (1960) Feb. 13 (3 pp.)

Paper deals with the putting to work of a large five-lift, spiral guided gasholder at Fulham works, England. Operations described are those which were carried out from the time when structure was completed to the final acceptance in the works' system of gas storage. In commissioning this holder there were two unusual features: 1) the introduction of a bactericide into the tank water in order to counter the bacterial generation of H_2S; and 2) the cold enrichment of the filling gas with commercial butane in order to reduce the normal loss of town gas associated with the changeover from purge gas.

Methane Liquefaction

Liquid Methane Shipment—Technique and Economics. J. J. McMullen. *Gas J. 301,* 226 (1960) Feb. 10 (7 pp.)

Author discusses the possible sources of natural gas, especially Venezuela, Arabia and Algiers, and the need for gas in Japan, Britain, and northern Europe. Properties of metals to contain the low-temperature gases,

and general elements in design of liquefaction plant and ship are mentioned, together with discussion of liquified petroleum gas ships now in use. Economics of natural gas prices and transportation costs including single- and multi-ship services to Europe, and costs of converting T-2 tankers are reviewed in some detail. The successful *Methane Pioneer* tanker has yielded some practical data on these latter problems, and set an example for designers of improved facilities.

Storage

Liquid Storage Tank. R. E. Rae (assigned to The Garrett Corp.) U. S. 2,922,287 (1960) Jan. 26.

A storage tank for low-temperature liquefied gas (hydrogen) is claimed which is comprised of a double-shelled tank, with each shell insulated, and with the space between shells traversed by the evaporated gas, which tends to cool the inner container and compensates for in-leakage of heat.

Underground Storage

Belgian Gas Supplier Builds Storage Tunnels to Take Off-Peak LPG, Cut Freight Costs. L. T. Minchin. *Gas J. 301,* 278 (1960) Feb. 17.

In Belgium, construction is now taking place of a vast underground reservoir for the storage of LPG so that propane and butane produced by Antwerp refineries can be accepted, even in midsummer. It is hoped that this will obviate the need for importing LPG from other countries and so cut out heavy freight costs involved at present. Site of installation is a 15-acre plot on the north bank of the River Scheldt, in Antwerp Harbor, chosen to accommodate tankers either bringing LPG for storage, or taking it away to cracking plants.

Underground Storage of Hydrocarbons. C. H. Brooks (assigned to Sun Oil Co.) U. S. 2,922,281 (1960) Jan. 26.

In a multiple-cavity underground storage installation for liquid hydrocarbons, the injection and recovery of hydrocarbons from separate storage units is controlled by automatic control of pressure in the manifold supplying the displacing brine. Brine above excess pressure is returned to surface tanks.

7. MANUFACTURED GAS AND CHEMICAL PROCESSING

Acetylene

High-Pressure Acetylene Chemicals. R. A. Labine. *Chem. Eng. 67,* 112 (1960) Feb. 22 (4 pp.)

First plant in this country to make acetylene derivatives via high-pressure synthesis is the Calvert City, Ky. plant of General Aniline & Film Corp. Representing a $6-million original investment, the plant is now operating at design capacity following a prolonged shakedown period. Flow sheet is presented which shows production of: butynediol, propargyl halide, propargyl alcohol, butenediol, butanediol, butyrolactone, pyrrolidone, vinyl pyrrolidone, polyvinyl pyrrolidone, and PVP-iodine.

Method for the Recovery of Acetylene from Gas Mixtures. G. A. Wetterholm and K. R. Fossan (assigned to Nitroglycerin A.G., Sweden) U. S. 2,921,648 (1960) Jan. 19.

An improved process is claimed for selective separation and recovery of pure acetylene from hydrocarbon pyrolysis gases, in which the latter gases are scrubbed, in one or more stages, by a dialkyl (such as dimethyl, or diethyl) sulfoxide at 20°C. The enriched sulfoxide is conducted to a tight vessel and "frozen" to 12°-13°C. The sulfoxide then crystallizes and acetylene is freed as a gas which may be recovered by pumping. Higher acetylenes and moisture may be removed from the sulfoxide periodically by heating.

Carbon Monoxide

Reductive Decomposition of Gypsum by Carbon Monoxide. T. D. Wheelock and D. R. Boylan. *Ind. Eng. Chem. 52,* 215 (1960) March (4 pp.)

When sulfur reserves are depleted, an economical process for manufacturing sulfuric acid from gypsum or anhydrite will be required. First step will probably involve release of SO_2 by sulfate decomposition. Conditions were determined for the rapid and quantitative conversion of gypsum to SO_2 and lime. Thus, when a gas mixture composed of 4% CO, 20% CO_2, 5% SO_2, and 71% N_2 was passed over—7 + 8 mesh particles of gypsum heated to 2200°F, decomposition was rapid and complete. Rate of decomposition is a function of temperature, gas composition, mass velocity, and particle size. Side reactions producing CaS can be suppressed. Results suggest that reductive decomposition is a potential method for commercial production of SO_2 and lime, and hence sulfuric acid, from gypsum.

Carbonization

Heat Procesing of Fine-Granular Coal Products. A. Jaeppelt, O. Diettrich, and O. Werner. U. S. 2,924,556 (1960) Feb. 9.

Non-coking fine coal is dried and carbonized in suspension continuously, by passing it with a flow of hot, oxygen-free combustion gases through a number of cyclones which have decreasing temperatures respectively from first to last. Coal is charged to the last cyclone, heated and separated from the gas and charged into the hot gas entering the next preceding cyclone, finally being separated at the first cyclone, where the hot gases attain 1100°C. The gases from the last cyclone are sufficiently heated to remove the tar vapors.

Pilot Plant Studies on the Production of Soft Coke by a Travelling-Grate Stoker Carbonizer. *J. Sci. Ind. Res.* (India) *19A,* 26 (1960) Jan. (6 pp.)

The possibilities of preparing soft coke for domestic heating purposes in a moving bed carbonizer with a traveling-grate for conveying sized coal into the heated zone of a built-in furnace, developed at the Indian Central Fuel Research Institute, are discussed. Principle involved is to devolatilize the coal to the required degree by the heat of combustion of the volatiles generated by passing a restricted quantity of air from

below the grate. Technique is superior to the stack burning process, particularly with respect to yield, and consistency and control of coke quality. Air-fuel ratio had a critical effect on the nature of coke produced. Impact and abrasion strength of coke, yield, and furnace efficiency are satisfactory up to 9% volatile matter in dry coke. Operating conditions are so adjusted as to leave a residual amount of volatile matter in the coke generally obtained in commercial quality domestic cokes in the market.

Catalysis

Chemisorption of Nitrogen on Iron Catalysis in Connection with Ammonia Synthesis. Part 1. The Kinetics of the Adsorption and Desorption of Nitrogen. J. J. F. Scholten, P. Zwietering, J. A. Konvalinka and J. H. de Boer. *Trans. Faraday Soc. 55,* 2166 (1959) Dec. (14 pp.)

An extensive gravimetric study was made of both the adsorption and desorption kinetics of nitrogen on a highly reduced single promoted iron catalyst. The activation energy of adsorption rises linearly with coverage up to $\theta = 0.22$. Above this value the activation energy remains constant at 23 kcal/mole. Activation energy of desorption decreases gradually with the coverage over the whole range investigated. Kinetics are discussed in terms of the absolute reaction rate theory. It appears that the chemisorptive behavior of the catalyst approaches the behavior of iron films. With the help of the isotherms found by equalizing the adsorption and desorption rates, a computation is made of the entropy of the adsorbed particles. Results lead to a picture of the state of nitrogen molecules on the surface which is in agreement with the kinetic data.

Dispersion of Platinum on Supported Catalyst. L. Spenadel and M. Boudart. *J. Phys. Chem. 64,* 204 (1960) Feb. (4 pp.)

Hydrogen chemisorption at saturation can be used to determine specific surface area and an average crystal size for platinum highly dispersed on an alumina support in a range of dispersion not accessible to measurements by X-ray line broadening. For a fresh catalyst containing 0.6 wt % platinum, the ratio of platinum atoms to adsorbed hydrogen atoms is almost equal to unity. This shows that the metal is very highly dispersed on the support. Platinum crystal growth is brought about by a heat treatment at elevated temperatures. Good agreement is obtained between platinum particle size calculated from chemisorption and from X-ray line broadening in a crystal size range where the latter method becomes applicable.

The Physical Nature of Supported Platinum. S. F. Adler and J. J. Keavney. *J. Phys. Chem. 64,* 208 (1960) Feb. (5 pp.)

Two types of platinum-alumina reforming catalysts, impregnated and cogelled, were examined by means of H_2 adsorption and X-ray line-broading techniques. Catalysts were examined 1) fresh, 2) coked, 3) regenerated, 4) mildly sintered, 5) severely sintered, and 6) reactivated after the two levels of sintering. Adsorption was shown to decline after coke had been deposited in a naphtha reforming reactor. A careful burnoff of the coke restored adsorption to at least one-half of its original level. Mild sintering, in a partial steam atmosphere, caused a large decrease in adsorption which was partially recovered after reactivation under a high pressure of O_2. On the other hand, sintering at one atmosphere of steam caused a decrease in adsorption which was essentially irreversible despite attempts at reactivation. Adsorption results on fresh, sintered and reactivated catalyst are interpreted by assuming 1) the existence of two types of platinum aggregation—monolayer for impregnated catalyst, pseudo-spherical for cogelled catalyst, and 2) that H_2 is adsorbed as atoms at the surface interstices between platinum atoms. Platinum particle sizes are derived that are in good aggrement with X-ray line-broadening values. The adsorption of H_2 per gram of platinum was found to be virtually independent of platinum concentration within either of the two graphs of catalysts investigated.

Coal Gasification

Coals for Complete Gasification. E. A. C. Chamberlain. *Gas J. 301,* 232 (1960) Feb. 10 (7 pp.)

Important paper discusses British coal needs for the Lurgi and Gaz Integrale processes (see *Gas Abstracts 16,* 36).

Gasification of Pulverized Coal at Atmospheric Pressure. G. R. Strimbeck, J. H. Holden, F. Bonar, K. D. Plants, C. D. Pears, and L. L. Hirst. *U. S. Bur. Mines Rep. Invest. 5559.* Pittsburgh: The Bureau, 1960 (72 pp.)

Work is reported on the gasification of pulverized coal at atmospheric pressure which involved studies of pilot plant development, process variables, and gasifying characteristics of coals of different rank. Coals of subbituminous C rank from Wyoming, bituminous A from West Virginia and anthracite from Pennsylvania were gasified satisfactorily over a wide range of coal throughput, oxygen-coal ratio and steam-coal ratio. Regression analyses of data permitted general conclusions on effect of operating conditions: oxygen requirement (CF/MCF gas produced) decreased with increase in coal-feed rate for bituminous A and anthracite; it decreased with decrease in oxygen-coal ratio for anthracite and subbituminous C, and passed through a minimum for bituminous A; coal requirement (lb/MCF gas produced) was lower at higher coal feed rates for bituminous A and anthracite, and decreased with an increase in oxygen-coal ratio; and oxygen and coal requirements usually did not vary appreciably with variation in steam-coal ratio. Also, oxygen requirement was much higher for anthracite, and was lowest for subbituminous; the same was true of carbon requirements. With decreasing order of coal rank, the carbon gasified increased, heat loss decreased, and exist-gas temperatures did not vary. Graphical comparisons of data by regression analysis and method of calculation are given.

Operation of Pressure-Gasification Pilot Plant Utilizing Pulverized Coal and Oxygen. J. H. Holden, G. R. Strimbeck, J. P. McGee, L. F. Willmott, and L. L. Hirst.

U. S. Bur. Mines Rep. Invest. 5573. Pittsburgh: The Bureau, 1960 (56 pp.)

Pressure-gasification pilot plant has been constructed by the Bureau of Mines in connection with their work on the production of synthesis gas directly from pulverized coal, oil and steam. Investigation was made with the following basic objectives: 1) determine the effect of varying pressure (75, 100, 150, and 300 psig), coal rate (400, 700, and 1,000 lb/hr), and oxygen-to-coal ratio (8 to 11 SCF/lb), on percentage of carbon gasified, oxygen and coal requirements per unit of $CO + H_2$ produced, exit-gas temperature, and heat loss. (Steam-to-coal ratio was maintained at approximately 0.3 lb/lb; 2) development of a stabilized gasification zone or reaction space; and 3) improvement in operability of the pilot plant.

The Pressure Gasification of Bituminous Coal. F. Bieger. *Gesammelte Berichte aus Betrieb u. Forschung der Rhurgas AG,* 13 (1960) No. 8 (7 pp. German text)

Together with the wide advances in use of oil and natural gas, there has also been much activity in improved gasification processes. In Germany, the large scale Dorsten coal gasification plant is an example. Much effort has been applied in increasing the yield of methane in the gas by changes in operating methods although in Dorsten, the required pipeline heating value is really obtained by admixing natural gas. Difficulty has developed with metallic corrosion in the generator from salt content of charged coal. This has been corrected by use of high chrome steels in repaired parts. The plant has proved to be an excellent peak load unit because of its great flexibility.

Question of Production of Illuminating Gas in Low-Temperature Coke Ovens by a Steam-Oxygen Cycle. A. E. Pinsker. *Gazovaya Prom. 5,* 18 (1960) Jan. (6 pp. Russian text)

In the Lurgi low-temperature coke ovens using the steam-oxygen cycle it is possible to produce high-calorific gas. After cleaning, the gas made at higher temperatures contains 457 Btu/CF, and the gas may be used for community gas supply. From yield and quality, this gas could supply primarily the Irkutsk region. Results of steam-oxygen pilot tests are tabulated, graphed and discussed.

Gasification of Fuels. R. Rummel (assigned to Union Rheinische Braunkohlen Kraftstoff A.G., Germany) U. S. 2,923,260 (1960) Feb. 2.

This improved fuel gasification process consists of a refractory shaft containing a deep turbulent layer of liquid slag at the bottom, which is kept in rotary motion over base and lower walls by a tangential blast of heated oxidizing gas. The crushed solid fuel is introduced by screws below the slag surface and steam is injected. The slag-floated fuel presents an increase reactive surface to gasifying agents during rotary motion, and accumulated new slag overflows through a central downspout.

Process for the Gasification of Carbonaceous Solid Fuel at Constant Volume. E. E. Donath (assigned to Koppers Co., Inc.) U. S. 2,925,335 (1960) Feb. 16.

Improved carbon conversion to synthesis gas is claimed by reaction at constant volume, wherein powdered coal and oxygen are blown with steam into a rigid pressure reactor preheated to 450°F, the mixture exploded electrically, with the temperature rise carrying the reaction with steam nearer to completion, and the gas after cooling and contraction, is exhausted to storage.

Hydrogen

Selas Hydrogen Generator Plant Features New System of Generation and Purification. *Ind. Heating 27,* 336 (1960) Feb. (2 pp.)

Complete processing plant for producing from 1000 to 10,000 CF/hr of high purity hydrogen incorporates a new concept in hydrogen generation and purification. Operation starts with hydrocarbon gas feed and depending upon composition of the feed-stock, hydrogen purity of up to 99.98% is possible. System is developed by Selas Corp., Pa. Flow diagram of process is presented. Hydrocarbon feedstock, treated for removal of sulfide impurities, is converted to crude hydrogen in steam-methane reforming furnace. In succeeding steps: crude gas is cooled; water is removed; and gas is compressed, cooled and last traces of water are removed before the gas passes through molecular sieves for removal of CO_2 and CO—final purification.

Process for Preparation of Carbon Monoxide. H. S. Johnson and A. H. Andersen (assigned to Shawinigan Chemicals Limited, Montreal) U. S. 2,921,840 (1960) Jan. 19.

A method of preparation of CO is claimed in which CO_2 is used to fluidize a bed of calcined minus 16 mesh petroleum coke particles. The bed is heated to 800-1200° C by current passed between graphite electrode. Preoxidation at 600° C and alkali impregnation of coke may be used.

Inert Gas

Estimate Inert Gas Plants Quickly. N. H. Prater and D. W. Antonacci. *Petrol. Refiner 39,* 129 (1960) Feb. (3 pp.)

Data are presented for estimating cost of inert gas plants in sizes of 1,000 to 100,000 standard CF/hr of inert gas capacity. Equipment selection requires a study of requirements of the processing plant, equipment, and general operating conditions. Size of plant, type of fuel, and available space and arrangement influence selection of equipment.

Liquefaction

New Details Round Out Liquid H_2 Story. *Chem. Eng. 67,* 61 (1960) Feb. 22 (2 pp.)

Information is presented on Stearns-Roger Mfg. Co.'s new plant for producing liquid hydrogen at Bakersfield, Calif. Hydrogen source is reformer offgas which S-R purifies and liquefies. Striking process technique gets refrigeration at very low temperatures to liquefy hydrogen. Article presents process outline together with flow diagrams of purification and liquefaction sections.

Oil Gas

The Use of P.F.D. in a Water Gas Plant. J. V. Craddock and R. W. Hind. *Gas World 151,* 316 (1960) Feb. 20 (5 pp.)

Paper describes the gasification of a light petroleum distillate in a water gas plant of the West Midlands Gas Board, England. Since present-day demands are for the heavier fuel oils, there is a surplus of the oil fraction, from which the light hydrocarbon feedstock is being taken. The feedstock, called Primary Flash Distillate or P.F.D., may be used for enriching blue water gas, by cracking in the carburetter in the normal manner. It can, in addition, be reformed, by passing the vapor through the fuel bed, during the normal backrun of the cycle. When reforming, the thermal yields from the raw materials cannot be calculated by the accepted water gas formulas.

Gas-Making Process. W. Hartley (assigned to Humphreys & Glasgow Ltd., England), U. S. 2,923,609 (1960) Feb. 2.

A cyclic regenerative process for oil gas manufacture is claimed which consists of a gas-making chamber, with a packed regenerative chamber at each end. In the blast period of the cycle, a combustion zone in a side chamber at base of one regenerator provides heat, while air (for carbon removal) passes down through this regenerator without sweeping the combustion zone. This air, mixed with combustion gases, heats the generator and second regenerator and leaves the set by a stack valve. On the "make" cycle, oil is injected into second regenerator while steam sweeps this vessel and the others in reverse direction.

Ore Reduction

Rotating Furnace Shakes up Iron Outlook. *Chem. Week 86,* 95 (1960) Feb. 27 (3 pp.)

Iron-making's swing from its traditional role as chemicals producer to chemicals consumer is emphasized by design work in progress at Stearns-Rogers. S-R is designing a prototype plant for Western Steel Corp., Inc. (Cheyenne, Wyo.) that will use nonpressurized hydrogen to reduce iron ore directly. Another novel feature, product will be iron powder—at a price one-fifth that of conventional powder processes. Article compares old method with new competitive process.

Petrochemicals

Chemical Economics. A Tool in Market Analysis. R. W. Schramm. *Chem. Eng. Progress 56,* 51 (1960) Feb. (4 pp.)

Article correlates chemical engineering economics with market analysis to establish parameters in a market. Procedures are presented for setting a selling price, deciding to make or buy; and sizing and locating a plant. A brief hypothetical case on an application is then presented. A 20-item bibliography is included.

Petrochemical Industry. T. L. Cubbage. *Chem. Eng. Progress 56,* 44 (1960) Feb. (2 pp.)

Future growth of petrochemical industry in the central states will not be tied to past performance, either as to rate or pattern. Specific segments of the industry must be considered in predicting future growth. With its ability to produce over 4,500,000 tons annually compared with demands totalling only 2,700,000 tons, the ammonia industry is currently suffering from acute overcapacity. Aromatics will become more generally available at refineries and a more extensive chemical program based on aromatics may develop. Acetylene-derived petrochemicals could get a big boost in the central states if acetylene made from natural gas becomes competitive with carbide acetylene.

Reformed Gas

Thermo-Catalytic Plants—the Otto Process for Town Gas Production. K. Osterloh. *Gas J. 301,* 184 (1960) Feb. 3 (5 pp.)

The reforming plants built by the Otto Co. work on the thermo-catalytic principle and are designed for feed stock of gaseous or low-boiling hydrocarbons, the upper limit of the boiling point being 150°C. The reason for this restricted range of feed stocks is ease of handling. The process makes no byproducts and the gas produced contains neither naphthalene, carbon black, nor tar. Process was developed by the Otto Co. in cooperation with the municipal gasworks at Dusseldorf, Germany. It is based on the combined steam/air catalytic cracking system. Catalyst support is aluminum or magnesium oxide, and nickel is a particularly suitable metallic catalyst.

Catalytic Reforming of Hydrocarbons. R. T. Kyle and A. Nilsen (assigned to The Gas Machinery Co.) U. S. 2,921,845 (1960) Jan. 19.

In a process for oil gas manufacture, an improvement is claimed in which two reforming chambers are provided, each containing superimposed regenerator, catalyst and fuel combustion zones, with the chambers connected at top by a large crossover. Injection of fuel oil into top of second chamber and combustion with air from base of second provides hot gases which pass through the crossover to heat first chamber packings, and are exhausted through waste heat stack. Gas making proceeds by steaming in the same gas path with oil injection, whereby the first chamber catalyst bed provides the final hydrocarbon reforming. The procedure is then reversed to heat and make in the second chamber, thus providing carbon removal from the catalyst bed.

Shale Oil

Hydrogenating Shale Oil and Catalytic Cracking of Hydrogenated Stocks. C. M. Frost, H. C. Carpenter, C. B. Hopkins, Jr., S. S. Tihen, and P. L. Cottingham. *U. S. Bur. Mines Rep. Invest. 5574.* Pittsburgh: The Bureau, 1960 (17 pp.)

Two recycle hydrogenation experiments to prepare catalytic cracking feed stock were made at 3000 lb pressure with crude shale oil retorted from Colorado shale in the gas-combustion retort. Hydrogenated product from the first experiment, made at 784°F, was

used for investigating the effects of nitrogen content on catalytic cracking yields and for determining the quality of the catalytically cracked gasoline. Hydrogenated product containing 0.14% or more of nitrogen produced less gasoline when cracked in a CAT "A" unit than was obtained from East Texas light gas oil cracked at the same conditions; product containing 0.10% or less nitrogen produced a quantity of cracked gasoline equal to that obtained from the East Texas light gas oil.

Synthesis Gas

Synthesis Gas from Fuel Oil. F. Ferling. *Erdol u. Kohle 12,* 959 (1959) Dec. (German text)

Pressure gasification results are discussed for the 10 MMCF/day synthesis gas plant of the Union Rheinische Braunkohlen Kraftstoff AG in Wesseling. Bunker C oil gasified at 1200°-1500°C at 30 atm with oxygen and steam by the Shell process, yields a gas of 46.1% CO and 48.3% H_2 which is pressure converted to 32% CO_2 and 64% H_2 after H_2S removal by alkazid process.

Synthetic Fuels

The Bureau of Mines Synthetic Liquid Fuels Program. 1944-55. Part 1. Oil from Coal. *U. S. Bur. Mines Rep. Invest. 5506.* Washington: Govt. Print. Office, 1959. $1.50 (306 pp.)

Report reviews research, done under the Synthetic Liquid Fuels Act, on producing oil from coal and oil shale. Information on research, development, problems, economic estimates, and outlook is presented for 1) gasification of coal, 2) underground gasification, 3) gas purification, 4) hydrogenation of coal, and 5) the Fischer-Tropsch synthesis. A bibliography of 237 references is included.

Physical Chemistry of the Fischer-Tropsch Synthesis. R. B. Anderson, J. F. Shultz, L. J. E. Hofer, and H. H. Storch. *U.S. Bur. Mines Bull. 580.* Washington: Govt. Printing Office, 1959, $0.25 (25 pp.)

Paper summarizes results of physicochemical studies of the Fischer-Tropsch synthesis undertaken by the Bureau of Mines. Criteria for activity in the Fischer-Tropsch synthesis are considered. For example, ferromagnetism is a satisfactory criterion of activity in elements of the iron group and their compounds. Effectiveness of iron catalysts after different pretreatments is examined. A precipitated ferric oxide containing copper oxide and potassium carbonate showed virtually the same activity after a variety of pretreatments; its selectivity, however, varied widely. Catalysts treated directly with synthesis gas or carbon monoxide were reduced to magnetite and yielded a high-molecular-weight product, whereas catalysts reduced in hydrogen, as well as those reduced in hydrogen and subsequently converted to carbide, yielded products of lower molecular weight. Those reduced in hydrogen and nitrided yielded products having the lowest molecular weight and high concentrations of oxygenated chemicals.

8. GAS DISTRIBUTION

Automation

Design and Operation of an Automatic Distribution Station. W. Moorcroft. *Gas World 151,* 286 (1960) Feb. 13 (4 pp.)

A station and district have been chosen to describe the design and operation which give actual costs of installation and operating results together with further long term planning proposals. Former costs of compression and attendance are highlighted by the results which show a reduction in distributing costs per therm after new plant, equipment and mains systems have been installed. New design has rectified an existing defective system and catered for future development up to the next 20 years.

Coatings

Pipe Lining Machine. A. J. Perkins (assigned to Perkins Pipe Linings, Inc.) U. S. 2,922,583 (1960) Jan. 26.

In a pipe lining applicator machine, an improved distributing head rotor is claimed, which comprises a pair of transverse end-plates, a number of radial vane plates (throwing plates) bridging between the end plates, with notched locking lugs extending through slots in the end plates, and with snap rings designed to fit the notches and lock the assembly upon the hollow rotor shaft of the distributor. Openings in shaft between end-plates permit extrusion of lining materials. Distributor is easily disassembled for replacement of worn parts.

Leakage

Mobile Leak Detection. M. G. Eilers. *Gas Age 125,* 19 (1960) March 3 (4 pp.)

Analytical methods in leak detection are preferred because not only can the escaping gas be detected, but the concentration can be measured and the hazard, if any, evaluated. In a rapidly growing system, need for speed without sacrificing accuracy becomes acute. Unit described here incorporates these assets and has given satisfactory service for more than three years without interruption for repairs.

Mains

Installing a 25-In. Main by the Earth Boring Method. P. Kerr. *Gas J. 301,* 193 (1960) Feb. 3 (2 pp.)

Paper describes a method by which a transverse pipe may be placed in the ground without disturbing the flow of traffic along a railway, canal, or roadway, as the case may be. Method, commonly known as thrust-boring, is explained by comparing it to an ordinary wood drill. Cutting edge cuts the wood and the spirals transfer the wood shaving up the hole to the surface. Essential point is that the machine has some solid anchorage against which it can pull. By means of the winch attached to it by a system of pulleys and wire rope, enough force is exerted to push the sleeve into the embankment.

Piping

1960 Plastics Pipe Survey Shows: The Infant Is Becoming a Child. *Gas 36,* 78 (1960) March (4 pp.)

Survey indicates that the number of companies using or experimenting with plastic pipe went up from 44 last year to 69 this year, a 57% increase. Footage installed, estimated early in 1959, was exceeded by 14%. Total plastic pipe in the ground by the end of the year will be 2422 miles.

Plastics Pipe Helps Gila Bend Get Gas. *Gas 36,* 82 (1960) March (6 pp.)

Arizona Public Service, at a time of short supply of steel, substituted acceptable plastics material, in the installation of a gas distribution system in Gila Bend, Arizona. Costs estimates are given for 1) actual combination steel and plastics system, and 2) all coated steel pipe system. Use of plastics resulted in a savings of about $14,000. Preliminary plastics pipe installation specifications are given including sketches showing method of running plastics pipe from a steel main, use of Mueller's plastics tee, terminating a plastics main which could possibly be extended in the future, and installation of valves in plastics mains.

9. GAS FUEL UTILIZATION AND APPLIANCES

Air Conditioning

Conditioned Air for Industry. L. E. Stewart. *Power 104,* 53 (1960) March (16 pp.)

Article discusses three major questions that must be decided before installing an air conditioning system: 1) What is really needed? 2) What techniques can be used? and 3) How will the system be designed? Controls necessary for air conditioning analysis involve temperature, humidity, ventilation, air circulation, air cleanliness and sound propagation. Each of these must be evaluated individually for each specific plant area. Four basic cooling cycles, spray, jet, absorption, and compression, are discussed and illustrated. Air cleaning systems are recommended. Final section guides the preparation of design date, system criteria and equipment specifications for a complete air conditioning job.

Industrial Air Conditioning. O. T. Zimmerman and I. Lavine. *Cost. Eng. 5,* 16 (1960) Jan. (2 pp.)

To estimate the costs of a central air-conditioning system, it is first necessary to determine the total cooling load, and then to estimate the cost of the component parts of a system which will meet the requirements. Article gives for sets of curves for estimating 1) cost of air-conditioning units, 2) cost of centrifugal refrigeration units, 3) cost of chilled water-circulating pumps, and 4) cost of cooling towers.

Air Pollution

Contaminant Concentrations in the Atmosphere of Los Angeles County. W. J. Hamming, R. D. MacPhee, and J. R. Taylor. *J. Air Pollution Assoc. 10,* 7 (1960) Feb. (10 pp.)

Paper describes long-term pollution trends as measured by the Los Angeles air monitoring network. During the three-year period, 1956-59, the general level of CO has been rising. This rise of 1 ppm/yr has not been reconciled with weather or other pollution factors. Rise in NO_2 was small and trends are available only from 1957. SO_2 varied slightly without changing its general level. Particulates declined during 1956 and 1957. This could have been due in part to the District's incinerator ban. Preliminary study on the basis of comparable weather factors appeared to justify this conclusion. Oxidant, eye irritant, and plant toxicant declined in 1956 and 1957 from a high in 1955, but exhibited a slight upturn in 1958. Winds and inversions appear to be the determining factors for these trends.

Evaluation of Methods for Controlling Vehicular Exhaust. W. Linville, R. G. Holmes and C. Kanter. *J. Air Pollution Assoc. 10,* 21 (1960) Feb. (8 pp.)

Article reviews, evaluates, and physically tests many types of automotive control devices and methods. It now appears that essentially complete hydrocarbon control must await development of a practical afterburner, either catalytic or direct flame. Lesser degrees of control, however, may be achieved through the use of devices operating essentially on the deceleration cycle. Fuel modification can be expected to decrease the smog forming capability of exhaust gas. Neither deceleration type devices, nor fuel modification alone, however, appear to offer an ultimate solution to the problem. Perhaps future combinations of methods and devices such as the combining of fuel enrichment with an afterburner will prove effective.

Eye Irritation from Air Pollution. C. H. Hine, M. J. Hogan, W. K. McEwen, F. H. Meyers, S. R. Mettier, and H. K. Boyer. *J. Air Polution Assoc. 10,* 17 (1960) Feb. (4 pp.)

Eye irritation remains one of the major demonstrable ill effects of community air pollution. Experimental work reported in this paper does not demonstrate any objective evidence of histologic or biochemical change following exposure to relatively high concentrations of single or combined pollutants or artificial smogs. Measurements using human panels, by a number of groups, have contributed to a further understanding of the factors which lead to the formation of the eye-irritating components of pollution air, even though these have not as yet been identified.

How Gas Fuel, Combined with Catalysis, Can Cure Air Pollution. R. J. Ruff. *Ind. Gas* (American) *38,* 4 (1960) Feb. (4 pp.)

Hydrocarbon and organic type fumes, vapors and odors are released from an extremely wide range of manufacturing operations. While the character, concentration, and continuity of the atmospheric emissions may be different, they have a common relationship. End products of complete oxidation of the various contaminants are identical—water vapor and CO_2—which are odorless, harmless and nonobjectionable-

type gases. Therefore oxidation of hydrocarbon and organic contaminants in air will result in complete destruction of the contaminants. Article discusses the combination of gas utilization with catalytic combustion to reduce atmospheric contaminants. Two methods are presented: direct combustion—heating of the process exhaust gases to the autogeneous combustion temperatures; and catalytic combustion—heating of the process exhaust gases to the catalytic ignition temperature only.

Combustion

"Pyrocore" Offers New Concept in Gas Combustion. G. Weiss. *A.G.A. Monthly 42,* 8 (1960) March (4 pp.)

Technical details of newly developed thermocatalytic combustion process are discussed. Nucleus of the system is the reactor (tradename "Pyrocore") which carries the thermocatalytic reaction. This reaction is based on the maintenance of a predetermined, stable combustion state involving the feedback of thermal energy from the reaction zone to a catalytically active layer beneath it. Future hopes are that the thermocatalytic process will develop into an inexpensive and highly efficient after-burner for the purification of automobile exhausts. Preliminary laboratory tests have shown a reduction of hydrocarbon content of the exhaust stream from 8500 to less than 20 ppm.

Dust Removal

Ash Separator Battery with Horizontally Disposed Separators. J. I. Yellott and P. R. Broadley (assigned to Bituminous Coal Research) U. S. 2,925,143 (1960) Feb. 16.

In a coal-dust-fired combustor system for driving a gas turbine, an improved ash and solids separator is claimed. This consists of a battery of barrel-like or hexagonal casings mounted horizontally in a box-like casing which serves as a dirty-gas feed chamber. A set of smaller tubular casings are mounted to fit concentrically into the outer barrel casings, with a vortical baffle welded to tubular outer surface so as to occupy the annular space. The tubular casings pass through the front wall of the dirty-gas feed chamber and are welded for support into a further forwardly placed wall of a common outlet chamber. Dirty gas cooled to turbine temperature enters the feed chamber, then the annular spaces where vortex motion is developed to throw solids to the outer rear wall, where a blow-down outlet pipe affords continuous removal of concentrated dust particles. The dust-free gas escapes forward through the inner tubular casings to the clean-gas plenum chamber, whence it is fed to the turbine. The box casing over the separator assembly is thermally insulated.

Flame Research

Estimate of Chemical Space Heating Rates in Gas-Phase Combustion with Application to Rocket Propellants. D. A. Bittker and R. S. Brokaw. *ARS J. 30,* 179 (1960) Feb. (7 pp.)

A simple, approximate method for calculating maximum chemical space heating rates in combustion processes is presented. Calculations are made by employing the fundamental physical and chemical properties of the combustion mixture. The results represent theoretical maximum possible heat release rate to be expected from a unit volume of a reacting fuel-oxidant mixture. Comparison of results with estimated heat release rates for same propellant in experimental rocket engines shows that the latter are several orders of magnitude less than the calculated maximum chemical rate for a given propellant.

The Mechanism of the Hydrogen + Oxygen Reaction in Aged Boric-Acid-Coated Vessels. R. R. Baldwin and L. Mayor. *Trans. Faraday Soc. 56,* 103 (1960) Jan. (12 pp.)

A detailed analysis has been made of the slow reaction data presented in an earlier paper so as to establish details of the reaction mechanism between H_2 and O_2 in boric-acid-coated vessels. The mechanism adopted provides a precise interpretation of the variation of maximum rate with mixture composition, total pressure, inert-gas addition and vessel diameter. It also interprets successfully both the absolute magnitude of the induction periods, and their variation with experimental factors.

The Second Limit of the Hydrogen + Oxygen Reaction in Boric-Acid-Coated Vessels. R. R. Baldwin, L. Mayor and P. Doran. *Trans. Faraday Soc. 56,* 93 (1960) Jan. (10 pp.)

Study of the slow reaction between H_2 and O_2 in aged boric-acid-coated vessels provided convincing evidence against the occurrence of the reaction $HO_2 + H_2O_2 = H_2O + O_2 + OH$ in the temperature range 470°-540° C. This reaction is an essential feature of the existing mechanisms to explain the quadratic branching characteristics of the H_2 and O_2 reaction in boric-acid-coated vessels, since it controls the concentration of H_2O_2 and hence the initiation rate. Present paper shows that by introducing the reaction $H + HO_2 = 2OH$ into the mechanism given for the slow reaction in aged boric-acid-coated vessels, an expression is obtained which accounts, in a more precise manner than previous mechanisms, for the second limit observations over a wide range of H_2 and O_2 mole fractions.

The Slow Reaction Between Hydrogen and Oxygen in Boric-Acid-Coated Vessels. R. R. Baldwin and L. Mayor. *Trans. Faraday Soc. 56,* 80 (1960) Jan. (13 pp.)

At 500°C and 500 mm Hg, the rate of reaction of a given H_2 and O_2 mixture in a vessel freshly coated with boric acid is quite slow. The rate increases slightly as the vessel ages until a critical point is reached when the rate increases rapidly over a short period of time, reaching a rate about 30 times faster than the original rate. Reaction is remarkably reproducible and displays kinetic features quite different from those previously reported for the H_2 and O_2 system. Reaction has been studied as a function of mixture composition, total pressure, inert-gas addition, vessel diameter and temperature, and a mechanism put forward to explain its unusual features.

Furnaces

Procelain Enameling of Aluminum Architectural Signs. *Ind. Heating 27,* 349 (1960) Feb. (3 pp.)

Enamel-coated sheets of aluminum up to 48″ by 120″ can be fired in the natural gas, radiant tube furnace described. Atmospheric burners under automatic control maintain temperature at 1,000°F to within ± 10°F. Gas oven, manufactured by Marveon of Ogden, Utah, is fired by means of three-inch stainless steel radiant tubes. Thirty-six atmospheric burners having a total Btu input of 800,000 are served with natural gas.

Heat Pump

Air-to-Air Heat Pump. J. Englund. *ASHRAE J. 2,* 56 (1960) March (5 pp.)

During the summer of 1954 a heat pump was built and installed in a residence in Pullman, Wash., to determine the electric load this machine creates in a northern climate. After five years of operational experience and study of weather, heat pump performance, energy requirements, and operating difficulties, author presents conclusions as to performance and occupant reaction. Residential heat pump, apart from supplemental heaters, is a relatively large user of electric power at a reasonable load factor. Electric supplemental heat can advantageously complement residential usage to give an overall load factor of the same order as the residence without a heat pump. Minor operating difficulties were reported with the starting mechanism of the motors and with the defrosting system.

Ovens

Combination Dry-Off and Baking Oven Used in Electrostatic Finishing of Automobile Door Frames. *Ind. Heating 27,* 356 (1960) Feb. (5 pp.)

An indirectly-fired gas oven is efficiently serving a dual purpose in the electrostatic finishing of door frames for Ford automobiles in a new plant at Fullerton, Calif. Both dryoff after metal cleaning and baking after enamel spraying are done simultaneously in the same oven. Diagrams of oven used are presented, together with description and illustrations of entire finishing operation.

Oxygen

The Use of Oxygen in Combustion Process with Particular Reference to the Steel Industry. T. C. Churcher. *J. Inst. Fuel 33,* 73 (1960) Feb. (13 pp.)

Paper describes work on the uses of combustion oxygen carried out by British Oxygen Research Development, Ltd. Work started with a theoretical study and laboratory experiments using a model furnace with a water-cooled hearth. Furnace was used to investigate the methods of using oxygen for flame enrichment. British Oxygen was closely concerned in several series of open-hearth trials carried out at Steel, Peech, Tozer, Ltd., Rotherham. Russian work on oxygen enrichment in conventional recirculatory open-hearth furnaces is described. Paper concludes by mentioning B.O.R.A.D. experiments using an oil burner and 100% oxygen.

Space Heating

The Engineer Looks at Direct Fired Radiant Heating. H. I. Miller, Jr. *Air Conditioning, Heating and Ventilating 57,* 65 (1960) March (4 pp.)

Radiant units, strategically placed overhead, expose to their surroundings ceramic elements heated to a bright red glow by the direct combustion of gas on the element surface. These units radiate heat directly onto workmen, floors, tools, and materials. No direct attempt is made to heat the air of the building. Article presents pros and cons deduced from a study of several installations including foundries and garages.

Performance of Hot Water Panel Heating Systems. W. S. Harris and E. L. Sartain. Eng. Experiment Station Bull. 453. Urbana: University of Illinois Press, July 1959, $1.00 (61 pp.)

Bulletin presents results of tests made on floor panel and ceiling panel heating systems. Systems were installed in the Floor Slab Lab. at the University of Illinois between the fall of 1951 and spring of 1954. Tests were designed to simulate current residential heating systems. Ceiling panels consisting of nominal ½-in. copper tube embedded in the plaster and floor panels consisting of ¾-in. black iron pipe laid on 12-in. centers in a 5-in. concrete floor slab were studied.

Piping and Pick-up Factors for Automatically Fired One-Pipe Hot-Water and Steam Systems. W. S. Harris and C. Fan. Eng. Experiment Station Bull. 455. Urbana: University of Illinois Press, Aug. 1959 (27 pp.)

Ratio of gross boiler output to the total connected load is called the piping and pickup factor. In the interest of economical installations, it is desirable to use as low a ratio as possible. This investigation supplies data on the effect of the size of the piping and pickup factor on the performance of hydronic (steam and hot-water heating) systems and provides a basis for determining minimum usable factor.

10. EQUIPMENT AND INSTRUMENTATION

Computers

Analogs Show the Way. T. J. Williams and V. A. Lauher. *Chem. Eng. Progress 56,* 71 (1960) Feb. (4 pp.)

Inherent quality of simultation makes analog computers good for teaching aids in classrooms, laboratories, and in-plant instruction courses. Listing is presented of computers with tabulations of components required for demonstration problems. An effective analog computer, particularly good for chemical-type problems, would cost over $5000. This would include a 10-15 amplifier computer, two channels of multiplication, one channel of function generation, and proper recording apparatus.

Computer Control of Processes. Part 1. Mathematics Is the Key. R. E. Kalman, L. Lapidus and E. Shapiro. *Chem. Eng. Progress 56,* 55 (1960) Feb. (6 pp.)

The computer control of chemical processes is dis-

cussed. Implementation of such control presents many difficult and intriguing technical problems, aside from the economic justification and the hardware required. Article outlines some problems, and reports on a research program to investigate the measurement and computational requirements for achieving such control.

Computer Control of Processes. Part 2. Is It Worth the Money? C. R. Hall. *Chem. Eng. Progress 56,* 62 (1960) Feb. (5 pp.)

The problem of applying computers in the control of processes to earn more money for chemical companies is discussed. Computer analysis of catalytic reaction system is presented. Application of a digital, internally-programmed, general purpose computer for control of a process will cost from $200,000 up. Author points out that there will be many chemical processes where, after comprehensive system analysis, lower process changes or lower cost control changes may be made which will achieve the benefits that a computer control would otherwise obtain.

Economic Design by Computer . . . the Computer Is Quicker than the Hand. J. W. Kellett and A. S. Perley. *Chem. Eng. Progress 56,* 67 (1960) Feb. (4 pp.)

Article presents experience, accomplishments and future plans of general purpose computer programs in three main sections: 1) historical summary of preparation of programs for design and cost estimating; 2) potentialities of computers in permitting use of improved calculation methods which are not feasible by hand, together with an example of a cost estimating program which uses such an improved method; and 3) present incentive and future potential for use of computers in design and cost estimating, and resulting future plans.

Controls

Proportional Peak Shaving and Standby Control. C. W. Warner. *Gas Age 125,* 30 (1960) Feb. 18 (4 pp.) Adapted from *Controlled Mixing of Gas,* C. W. Warner. Complete handbook available free from Cutler-Hammer, Inc, Milwaukee, Wis.

A gas-mixing control system is described which provides an LPG-air peak shaving plant with automatic maintenance of selected percentage of peak shaving, automatic change to complete standby if plant is in operation, and automatic control of the LPG-air mixture heating value. Article discusses operating procedure and gives flow diagram, and design and operating curves for standby and automatic peak shaving control.

Fluid Flow

Centrifugal Flow Measurement. J. T. Cortelyou. *Instruments & Control Systems 33,* 276 (1960) Feb. (5 pp.)

Flow can be measured simply by using the centrifugal force developed in a circular loop of pipe. A comparison is presented between the full circle pipe-bend centrifugal meter and an orifice meter. The centrifugal meter has following features: 1) coefficient determined directly from a formula rather than empirical test data, 2) coefficient that does not vary with flow rate or viscosity, 3) relative immunity to pulsation errors, 4) extreme simplicity, and 5) no reduction in pipe cross-section area. Formulas for gas and liquid flow are discussed.

Heat Exchangers

Heat Conductivity Factors in Crude-to Clean Gas Heat Exchangers. W. Haurin. *Gas u. Wasserfach 101,* 7 (1960) Jan. 2 (5 pp. German text)

In the planning and construction of plants which serve for heat exchange between gases, the plant is designed from heat conduction factors to be found in the available literature. Present research establishes how heat conductivity factors in gas-to-gas exchangers are affected by different stream velocities, different specific heating surface loading and by variable condensate content of gases. Calculations, tables and graphs are presented.

How to Design Heat Exchanger Piping. R. Kern. *Petrol. Refiner 39,* 137 (1960) Feb. (16 pp.)

Details of exchanger layout and piping design are presented. Piping economy and good engineering design depends more on knowing what alterations can be made to exchangers than on actual piping design know-how. Designer can influence exchanger design (direction of flow, nozzle location, etc.) in the interest of better, more functional piping design.

Heat Transfer

Steam Injection Heating. A. I. Morgan, Jr. and R. A. Carlson. *Ind. Eng. Chem. 52,* 219 (1960) March (2 pp)

Steam injection is the fastest and simplest means of heating, where it is applicable. Steam flows into the liquid in jets which are tangential to the cross section of liquid and nearly normal to the direction of liquid flow. The steam jets pulse in the low audio range. Average time of condensation is a few milliseconds. Good design results in turbulent flow of a deaerated liquid past ¼-inch ports, through which steam flows at sonic velocity.

High Pressure Equipment

Ultra-High-Pressure, High-Temperature Apparatus: the "Belt." H. T. Hall. *Rev. Sci. Instruments 31,* 125 (1960) Feb. (7 pp.)

Equipment is described for maintaining pressures of 100,000 atm at temperatures in excess of 2000°C for long periods of time. Equipment makes use of conical Carboloy pistons that push into each end of a specially shaped Carboloy chamber. Both chamber and piston receive lateral support from stressed binding rings. Axial motion of the conical pistons in and out of the chamber is accomplished (while still maintaining a pressure seal) by the use of a specially shaped sandwich gasket made of naturally occurring pyrophyllite and a steel cone. The arrangement gives a multistaging effect in a single stage. Pyrophyllite in addition to its use in the gasket is also used as pressure transmitting

medium, thermal insulation, and electrical insulation. Sample is heated by passage of an electric current through a metal or graphite tube. Methods of pressure and temperature calibration as well as construction details are discussed.

Pumps

High-Vacuum Pumps. O. T. Zimmerman and I. Lavine. *Cost Eng. 5,* 4 (1960) Jan. (4 pp.)

Curves are presented for estimating costs of 1) single- and two-stage rotary oil-sealed high-vacuum pumps, and 2) metal-housing oil-vapor diffusion, ejector, diffusion-ejector pumps, and fractionating diffusion pumps. Tables are included for estimating quantity of oil required in mechanical and vapor pumps.

Temperature Measurement

Suitability of Carbon Resistors for Field Measurements of Temperatures in the Range of 35° to 100°R. NASA Tech. Note D-264. A. C. Herr, H. G. Terbeek, and M. W. Tiefermann. Washington: Nat. Aero. and Space Admin., Feb. 1960 (16 pp.) $0.50.

Material is presented for using a carbon composition resistor to measure temperature in the range of 35°-100° R to an accuracy of 1% of the absolute temperature. Important characteristics of the resistor as a sensing element are discussed together with circuitry especially suited to field-type instrumentation.

Thermal Conductivity

Thin-Heater Thermal Conductivity Apparatus. N. E. Hager, Jr. *Rev. Sci. Instruments 31,* 177 (1960) Feb. (9 pp.)

Apparatus is described for measuring the thermal conductivity of insulating material. A constant current is passed through a rectangular sheet of stainless steel foil in such a manner that the rate of generation of heat per unit area can be computed from electrical measurements. Identical sample slabs are placed against opposite sides of the heater, and the combination is enclosed in a plastic film and immersed in a bath having constant and uniform temperature. When thermal equilibrium is reached, the temperature drops across the central portions of the sample slabs are measured with differential thermocouples. The elementary one-dimensional form of the Fourier heat transfer equation is used to compute the thermal conductivity from the observed quantities. In preliminary tests with representative insulating materials, equilibrium is reached within 15 min. It is estimated that the apparatus is capable of giving measurements accurate to within 2%, and experimental results are not inconsistent with this estimate.

11. MATERIALS OF CONSTRUCTION, AND CORROSION

Cathodic Protection

Advances in Cathodic Protection of Tankers. D. Spector. *Corrosion Tech. 7,* 5 (1960) Jan. (4 pp.)

Cathodic protection within ballasted cargo compartments in tankers has now been employed for almost a decade; about 1000 tankers have been so protected. Results have been widely published and varying degrees of success reported. Spectacular results obtained under specific conditions perpetuated its widespread application in tankers. One particular advance, taking advantage of constructional members of the ship, is described here. System has recently been patented.

Control of External Corrosion on TAPLINE. F. M. Maasry. Part 2. *Pipe Line News 32,* 45 (1960) Feb. (5 pp.)

Part 2 discusses protection achieved from the five 100-volt, 70 amps pump station rectifiers. Magnesium program on the short buried section in high-resistivity soils was generally found to be inadequate. Constant increase in current requirement due to progressive settling of backfill around the pipe and deterioration of pipe coating, necessitated establishment of cathodic protection stations at shorter intervals in the line. Diesel-driven generators were found to be the most economical source of current (see *Gas Abstracts* 16, 42).

A History of Cathodic Protection. C. R. Davis. *Gas 36,* 129 (1960) March (11 pp.)

Article presents a history of cathodic protection developments as experienced by Montana Power Co. from 1934 to 1958. Experience proves that: 1) it is necessary to have complete supervision by a qualified engineer; 2) proper instruments must be available; 3) section to be protected must be insulated from other systems by insulated joints and bushings; 4) readings on output must be examined monthly and adjusted if necessary; 5) it is feasible to protect bare pipe, but even a coat of primer will greatly reduce cost of cathodic protection.

Coatings

Improved NBS Abrasive Jet Method for Measuring Abrasion Resistance of Coatings. Tech. Paper 52. A. G. Roberts. *ASTM Bull.,* 48 (1960) Feb.

A description is given of the many improvements made in the NBS Abrasive Jet Method for measuring abrasion resistance of coatings. The Abrasive Jet Method utilizes a jet of fine abrasive particles, under closely controlled conditions of flow, pressure, distance, and angle, to abrade through the coating to the substrate in a time operation. First show of bare substrate is taken as the end point and is usually clearly evidenced visually by an abrupt change in color or gloss. Abrasion resistance is ordinarily expressed in terms of time per unit thickness of coating; however, coatings of similar thickness may be intercompared on the basis of total abrasion time. Very good reproducibility is obtained.

Modern Plant Coats Pipe. D. C. Benson. *Gas 36,* 74 (1960) March (4 pp.)

Description is given of the pipe coating plant operation by Memphis (Tenn.) Light, Gas & Water Division.

Corrosion

Corrosion Prevention in Gas Distribution Systems. D. P. Price. *Gas 36,* 68 (1960) March (6 pp.)

Protecting a gas distribution system against corrosion is often very difficult. Educated use of many available tools is needed. Education of personnel is required. Communications between corrosion engineers and men in the field are essential. Article discusses ideas and techniques of a corrosion elimination program in a gas distribution system, including information on coatings, insulation, cathodic protection, and stray currents.

Plastics

Teflon Bids Anew for CPI Piping Dollars. *Chem. Week 86,* 101 (1960) Feb. 27 (2 pp.)

Statistics are presented which show that the installed cost of Teflon-lined pipe is now competitive with glass-lined steel, and inching up on Monel, latter being in the stainless-steel price range. Teflon resin price cuts, which brought price down 20% during 1959, are expected to spur further reductions. Resistoflex has cut its prices more than 20% since its first price list was issued in late 1957. These cuts reflect improvements in processing methods, as well as price reductions by resin-maker Du Pont.

12. ANALYTICAL METHODS AND TESTS

Chromatography

Theoretical Plates in Gas Chromatography. Effects of Distribution Ratio, Viscosity, and Amount of Liquid Phase. J. J. Duffield and L. B. Rogers. *Anal. Chem. 32,* 340 (1960) March (4 pp.)

Value of the mass-transfer term in the van Deemter, Zuiderweg, and Klinkenberg equation increases with the viscosity and volume of the liquid phase. For distribution ratios greater than unity, the term is larger for the smaller ratios. With an increase in the mass-transfer term, lower efficiencies are observed and adjustment of the flow rate for optimum conditions is critical. The optimum flow rate for inefficient columns is generally slow; hence long times are necessary for analysis. Very small samples of vapor rather than liquid were used successfully and required no extrapolation to zero size.

Dust

Apparatus for Automatically Counting and Sizing Airborne Particles. A. V. Appel, H. T. Betz, M. A. Fisher, E. G. Fochtman, S. Katz, A. Lieberman, N. E. Alexander, J. L. Murphy, D. C. Maxwell, and R. E. Lewis (assigned to U. S. A. as represented by the Sec. of the Army) U. S. 2,920,525 (1960) Jan. 12.

A system for detecting, measuring and counting particulate matter in a fluid is given, comprising an aerosol handling system including a diluter. A portion of the aerosol flow is withdrawn, filtered and returned to the aerosol stream, thereby reducing the particulate matter per unit volume. Optical means for illuminating a viewing zone and means for optically detecting the amount of light scattered by the aerosol particles are described. The light is then translated and scattered into discrete electrical pulses. Electronic equipment amplifies and classifies the pulses into groups on the basis of magnitude and registers them in separate channels of the instrument.

A Routine Sampler for Detecting Variations in the Emission of Dust and Grit. B. Lees and M. C. Morley. *J. Inst. Fuel 33,* 90 (1960) Feb. (8 pp.)

The report of the Committee on Air Pollution, 1954, recommended that simpler standard methods of sampling flue gases to determine grit emission should be devised. Sampler described has been developed for routine sampling on a comparative basis. It is extremely simple, yields consistent results and requires only a few minutes per day for routine control. Its application is described for assessing on a routine basis the efficiency of collection of grits by mechanical arrestors and the performance efficiency of electrostatic precipitators on boilers fired with pulverized coal.

Hydrocarbons

Development of a Molar Refraction Equation Suitable for the Structural Analysis of Hydrocarbons. M. L. Boyd and D. S. Montgomery. *J. Inst. Petrol. 45,* 359 (1959) Dec. (14 pp.)

An equation has been developed which expresses, in terms of five structural groups, the molar refraction (Lorentz-Lorenz expression) of 118 pure hydrocarbons that were prepared by an API project. This equation was specifically designed for structural analysis purposes. Accuracy with which it expresses molar refraction of these compounds has been tabulated for comparison with the accuracies obtained for a similar expression previously derived for the molar volume.

Development of a Molar Volume Equation Suitable for the Structural Analysis of Hydrocarbons. M. L. Boyd and D. S. Montgomery. *J. Inst. Petrol. 45,* 345 (1959) Dec. (14 pp.)

Equation presented expresses the molar volume of 130 pure hydrocarbons prepared by an API project in terms of five structural groups. Equation is intended for the structural analysis of hydrocarbons and has been discussed in this regard. Accuracy with which this equation expresses the molar volume of these compounds has been tabulated and compared with the values calculated from the equation of Kurtz and Sankin.

Determination of Hydrocarbon Oxidation Products. Reverse Isotope Dilution Analysis. W. H. Clingman, Jr. and H. H. Hammen. *Anal. Chem. 32,* 323 (1960) March (3 pp.)

To determine the products from radiation-induced oxidation of propane, reverse isotope dilution analysis was investigated. Method was chosen because of the possible complex nature of the product and small sample size. Analytical data demonstrated that individual members of a homologous series may be determined without interference from each other by

using recrystallization of a suitable derivative as the purification method. If only one compound in the sample is determined, there need no separation of products prior to this final purification. Method should find application whenever the components to be determined are particularly difficult to separate, as in analysis of hydrocarbon oxidation products.

Infrared Spectroscopy

Infrared Spectra of Hydroxy-Aromatic Organic Compounds. W. Beckering and W. W. Fowkes. *U. S. Bur. Mines Rep. Invest. 5505.* Washington: Govt. Print. Office, 1959. $0.50 (100 pp.)

In characterizing tars obtained by low-temperature carbonization of North Dakota lignite, infrared spectra are an invaluable aid in both qualitative and quantitative examination. Group of spectra presented, representing 97 compounds of largely phenolic materials, will be used for further study of coal tars.

Infrared Spectroscopy of Surface Coatings in Reflected Light. H. Dannenberg, J. W. Forbes, and A. C. Jones. *Anal. Chem. 32,* 365 (1960) March (6 pp.)

Infrared spectroscopy has been applied to organic coatings on metal substrates by the use of a reflection method. A commercial spectrophotometer is employed with a special reflectance accessory. Infrared light beam passes through the coating, is reflected from the substrate, passes through the coating again, and finally enters the spectrophotometer. This method produces good spectra of clear surface coatings, 0.1-0.5 mil thick, on flat surfaces of specularly reflective metals such as tin-plated steel, cold-rolled steel, aluminum, and brass. Method appears to be useful for qualitative and semiquantitative work.

Organic Sulfur

Desulfurization as a Method of Identifying Sulfur Compounds. C. J. Thompson, H. J. Coleman, C. C. Ward, and H. T. Rall. *Anal. Chem. 32,* 424 (1960) March (7 pp.)

A micromethod has been developed for the catalytic removal of sulfur from sulfur compounds to yield hydrocarbons for which standard compounds are available. Data are presented showing the desulfurization of typical members of the sulfur compound classes: alkane and cycloalkane thiols, alkane and cyclic sulfides, thiophenes, and benzothiophenes. Method is simple and direct and is applicable to fractions, from gas-liquid chromatographic columns, of less than 0.0002 ml. Method has been applied successfully to the identification of sulfur compounds in concentrates from distillate fractions and it is anticipated that it will be useful in this and similar fields.

Sulfur

Determination of Sulfur in Petroleum Products by Hydrogenation. E. C. Schulter, Jr., E. P. Parry, and G. Matsuyama. *Anal. Chem 32,* 413 (1960) March (5 pp.)

A rapid method for the determination of sulfur throughout a wide concentration range is described. The sample is heated in a hydrogen stream and passed over a nickel catalyst at 1200°C. Sulfur is converted to H_2S and absorbed in a dilute NaOH solution. Absorbed H_2S is titrated amperometrically with standard mercuric chloride solution if the sulfur concentration is above 0.1%. Below 0.1% sulfur, the methylene blue method is used to determine as little as 5 ppm of sulfur in a 0.2-gram sample.

Sulfur Oxides

The Determination of Sulphur Trioxide and Sulphur Dioxide in Flue Gases. R. S. Fielder, P. J. Jackson and E. Raask. *J. Inst. Fuel 33,* 84 (1960) Feb. (7 pp.)

A compact portable apparatus and a simplified technique have been developed for the rapid determination of the concentrations of SO_3 and SO_2 in flue gases. The turbidimetric determination of SO_3 used by previous workers has been modified. The more sensitive procedure evolved requires at most a 10-liter sample of flue gas for a determination, and determinations may be made at an average rate of one every 15 to 20 min. The apparatus and method described have been used extensively in the field and in the laboratory and have proved convenient and reliable.

13. BASIC SCIENCE

Diffusion

Molecular Diffusion Studies in Gases at High Temperature. Part 4. Results and Interpretation of the CO_2-OX, CH_4-O_2, H_2-OX, CO-O_2, and H_2O-O_2 Systems. R. E. Walker and A. A. Westenberg. *J. Chem. Phys. 32,* 436 (1960) Feb.

Experimental measurements of the binary diffusion coefficients for the above systems over the nominal temperature range 300°-1000°K are reported. Measurements were made by the point source technique. Data have been analyzed in terms of intermolecular potential energies and the rigorous kinetic theory by using the Lennard-Jones, modified Buckingham, point center of repulsion (inverse power), and the exponential repulsion energy functions. It is shown that all four of these functions are capable of fitting the diffusion data with about the same precision (within experimental error). However, the potential energy values themselves which are calculated from these four different fitted models are shown to be widely at variance; especially in the range of interaction corresponding to the lower temperatures. Results provide an example of the high degree of ambiguity involved in deducing intermolecular potential energies from transport data. The use of such fitted potentials to extrapolate transport data to higher temperatures, is a more reliable procedure, and diffusion coefficients for the above five gas pairs (in their unexcited, undissociated states) have been estimated to 3000°K from the potentials based on the 300°-1000°K.

Heat Transfer

Determination of the Temperature of a Flow between Heating and Cooling Surfaces. O. A. Dyban. *Dop. Akad. Nauk URSR,* 269 (1957) No. 3 (4 pp. Russian text); [From *Applied Mech. Rev. 13,* 137 (1960) Feb.]

Paper determines analytically the temperature at an arbitrary point in a strip between the generatrixes of two bodies with different heat potentials. Author derives an equation for the mean temperature of the cooling flow, the experimental apparatus used consisting of two hollow cylinders of different diameters, slid one over the other, a hot liquid going through one cylinder and a cold one through the other.

A. V. Kur'yato
Courtesy Referativnyi Zhurnal, USSR
Translation, courtesy Ministry of Supply, England

Experimental Investigation of Heat Emission by Boiling Freon-12. V. Lavrova. *Kholodil'naya Tekhnika,* 55 (1957) No. 3 (7 pp. Russian text); [From *Appl. Mech. Rev. 13,* 137 (1960) Feb.]

The study deals with the investigation of the heat emission from the hot outside surface of a single tube of liquid freon-12 in conditions of natural convection. A detailed description is given of the apparatus used. The experiments were carried out at a pressure of 1.86 atm (which corresponds to a saturation temperature for the freon-12 of —15°). The results of the experiments showed that the boiling of the liquid began at a value for the specific thermal load of $\geqslant$ 2000 Kgcal/m^2 hr, while the transition to the actual boiling state was accompanied by jump-like increases of the coefficient of heat emission. A comparison of the experimental data with the different calculation semi-empirical relations showed good agreement with the relation proposed by Kruzhilin.

V. P. Mugalev
Courtesy Referativnyi Zhurnal, USSR
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Superheating and Distribution of the Temperature in the Liquid and Vapor of Boiling Liquids. A. S. Vos. *Ingenieru 71,* 7, 0.17-0.20 (1959) Feb. (Dutch text); [From *Applied Mech. Rev. 13,* 137 (1960) Feb.]

A survey is given of the temperature distribution when the liquid and vapor are in equilibrium, when there are vapor bubbles and when they are absent, an inquiry into the superheating temperature of the heater producing the first vapor bubbles, and a discussion of some effects influencing the maximum heat transfer in nucleate boiling. In liquids without generation of bubbles the superheating effect will be some degrees Celsius; when there are bubbles, the superheating of the liquid is limited to some tenths of a degree Celsius. In the boundary layer immediately against the heater the superheating is much higher.

From author's summary

Hydrocarbons

The Vapor Pressures of Some Hydrocarbons in the Liquid and Solid State at Low Temperatures. W. T. Ziegler. Nat. Bureau of Standards Tech. Note 4. Washington: Dept. of Commerce, May 1959, $0.75 (17 pp.)

In the analysis of low-temperature processes such as purification of H_2 and the design of apparatus such as low-temperature distillation or scrubbing equipment, cryogenic baths, etc., a knowledge of vapor pressure of hydrocarbons is needed. Paper presents vapor pressure of the following hydrocarbons: methane, ethane, propane, n-butane, isobutane (2-methyl propane), n-pentane, ethylene, propylene, 1-butene, acetylene and cyclopropane. Range is from 1500 mm down to approximately 0.001 mm Hg.

Hydrogen

Swedish Heavy Water Process. B. J. Eriksson. Part 1. *Chem. & Process Eng. 41,* 5 (1960) Jan. (3 pp.); Part 2. *Ibid.,* 53 (1960) Feb. (5 pp.)

A process has been developed in Sweden for the manufacture of heavy water by the dual-temperature isotope exchange between H_2S and water. Part 1 describes the organization and scope of the Swedish heavy water program and gives details and technical factors involved of the first pilot plant. In Part 2, the second pilot plant is described and consideration is given to the optimum design of full-scale plant and the economics involved. A cost of $28/lb, which is close to the Atomic Energy Commission price, seems reasonable even with a realistic rate of amortization and a small plant production of 25 tons/yr.

Hydrogen Sulfide

Solubility of Hydrogen Sulfide in Methanol at Low Temperatures. Y. D. Zel'vanskii and A. B. Strunina. *Gazovaya Prom. 5,* 42 (1960) Jan. (6 pp. Russian text)

A dynamic method was used to determine the solubility of H_2S in methanol at 0°, −25.6°, −50°, and −78.5°C at intervals of H_2S pressure from 15-480 mm Hg. Results obtained show that H_2S solubility is five to six times greater than that of CO_2 under the same conditions. For H_2S concentrations up to 10 mole percent, the solubility follows Henry's law. It is shown that solubility of H_2S is reduced in presence of CO_2 in the solution, reduction being greater with increased content of the latter.

Methane

Phase Transitions and Compression of Solid CH_4, CD_4, and O_2. J. W. Stewart. *J. Phys. Chem. Solids 12,* 122 (1960) Jan. (8 pp.)

The piston-displacement technique previously described has been applied to a study of the phase transitions and isothermal compressibility of solid CH_4, CD_4 and O_2 over the pressure range of 0-19,000 kg/cm^2 and the temperature range 4°-120°K. Phase transitions appear as discontinuities in V (first order) or in $(dV/dp)_T$ (second order). Solid CH_4 and CD_4 both show three phases and one triple point. Transitions appear to be of the second order, with rather large "regions of indifference." There are isotopic differences between the two methanes. At atmospheric pressure CH_4 shows

only one of the transitions, at 20.5°K, while CD_4 has both, at 22.1° and 27.2°K.

Phase Equilibria

Get K-Values by Chromatography. G. L. Mellado and R. Kobayashi. *Petrol. Refiner 39,* 125 (1960) Feb. (4 pp.)

Application of gas-liquid partition chromatography (GLPC) to obtain partition coefficients consistent with static vapor-liquid equilibrium measurements has been reported earlier. The relation of GLPC to extractive distillation and calculation of partition coefficients and K-values for methane and ethane dissolved in other hydrocarbons also have been developed earlier. These relationships are reviewed and experimental results presented on a study of *n*-butane and *n*-dodecane. Data for other C_4 hydrocarbons are discussed and needed improved techniques for systems of lighter hydrocarbons are mentioned.

Photochemistry

Reactions of Methylene. Part 4. Propylene and Cyclopropane. J. N. Butler and G. B. Kistiakowsky. *J. Am. Chem. Soc. 82,* 759 (1960) Feb. 25. (7 pp.)

Photochemical reactions of ketene and diazomethane with cyclopropane and with propylene, each present in large excess, were studied using radiation of different wave lengths and the products were analyzed by gas chromatography. Products were attributed mainly to the reactions of methylene formed in the primary photochemical processes. Initial product of reaction of methylene with cyclopropane is energy-rich methyl cyclopropane which isomerizes unimolecularly into a mixture of butene isomers unless stabilized by collisions. The reaction of methylene with propylene involves two competitive initial processes: a reaction with the C=C double bond, forming energy-rich methylcyclopropane and reactions with the C-H bonds which give a mixture of isomeric butenes. Methycyclopropane formed also rearranges into butenes unless stabilized by collisions. Lifetimes of energy-rich methylcyclopropane molecules depend greatly on the source of methylene and also on the choice between cyclopropane and propylene.

Surface Area

Surface: A Common Problem of Research and Engineering in Fuel Technology. P. O. Rosin. *J. Inst. Fuel 33,* 50 (1960) Feb. (19 pp.)

Paper reviews 40 years of the activities of author and his associates in studies of the effects of surface factors in fuel research and technology. Early work in industrial furnace problems such as combustion space, fuel reaction rates and surface areas, particle size vs. areas, and aerodynamics in furnaces are discussed generally. Progress in technology resulting from fuel surface research is developed for fields of heat transfer, fluidization, drying of solids, and fuel firing.

Temperature Measurement

The "1958 He^4 Scale of Temperatures." Part 1. Introduction. F. G. Brickwedde. *J. Research A. Phys. Chem. 64,* 1 (1960) Jan.-Feb. (4 pp.); **Part 2. Tables for the 1958 Temperature Scale.** H. van Dijk, M. Durieux, J. R. Clement, and J. K. Logan. *Ibid.,* 4 (1960) Jan.-Feb. (14 pp.)

The generally used practical scale of temperatures between 1° and 5.2°K is the He^4 vapor pressure scale based on an accepted vapor pressure equation or table. In Sévres (near Paris), Oct. 1958, the International Committee on Weights and Measures recommend for international use the "1958 He^4 Scale" based on a vapor pressure table arrived at through international cooperation and agreement. This table resulted from a consideration of all reliable He^4 vapor pressure data obtained using gas thermometers, and paramagnetic susceptibility and carbon resistor thermometers. The theoretical vapor pressure equation from statistical thermodynamics was used with thermodynamic data on liquid He^4 and the vapor equation of state to insure satisfactory agreement of the vapor pressure table with reliable thermodynamic data.

Thermal Conductivity

Thermal Conductivity of Binary Mixtures of Diatomic and Monatomic Gases. B. N. Srivastava and A. K. Barua. *J. Chem. Phys. 32,* 427 (1960) Feb. (9 pp.)

Thermal conductivity of the binary mixtures of O_2-He, O_2-Ne, O_2-Kr, and O_2-Xe were measured at 30°C and 45°C for various compositions by using the thick-wire-variant of the hot-wire method. For pure O_2, the experimental value of the thermal conductivity is lower than that given by the recent theory of Hirschfelder based on the assumption of local chemical equilibrium, and consequently the values calculated from Hirschfelder's formula for the mixture conductivities are also expected to be higher than the experimental values which is actually found to be so for the mixtures investigated here. The agreement becomes excellent when the experimental values of the conductivity of pure O_2 are used to calculate the mixture conductivities. The formula for the mixture conductivities was tested in detail and was found to give satisfactorily the composition dependence.

Introduction to the Technology of Ultrasonics. J. Matauschek. (Berlin: VEB Verlag Technik, 1957) 535 pp. German text; [From *Appl. Mech. Rev. 13,* 148 (1960) Feb.]

Main sections of this valuable addition to the small number of books on ultrasonics are: A. The physics of ultrasonics: sound; specific properties; and effects of ultrasonics. B. The techniques of ultrasonics: mechanical generation of ultrasonics; theory of ultrasonic generators using electromechanically active materials; electrical generation of ultrasonics; receivers and measuring techniques; optics of ultrasonics. C. The applications of ultrasonics. More than 700 selected references give the reader the possibility for extensive studies. Tables and pictures supplement the text competently. The book should be of great benefit to the engineer but should also be well adapted to the college student of the graduate level.

H. J. Ramm, USA

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Battelle Technical Review
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